DOCUMENT RESUME

ED 311 225 CE 053 210

TITLE	Principles of Technology Curriculum Guide. Curriculum Development. Bulletin 1812.
INSTITUTION	Louisiana State Dept. of Education, Baton Rouge. Div. of Vocational Education.
PUB DATE	87
NOTE	327p.; Portions contain marginally legible print.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC14 Plus Postage.
DESCRIPTORS	*Energy; *Force; Industrial Arts; *Power Technology; Secondary Education; State Curriculum Guides; *Technological Literacy; *Technology
IDENTIFIERS	*Principles of Technology (Course); *Resistance (Physics)

ABSTRACT

This document describes minimum competencies and suggested student activities for a seven-unit course called Principles of Technology. The instructional units are called Force, Work, Rate, Resistance, Energy, Power, and Force Transformers. The first section of the document contains information on how to use the guide, goals for industrial arts/technology education, goals of teaching science, and the primary processing skills. For each unit, the guide contains unit objectives, learning activities, and concepts to be learned and their associated student objectives. For each concept, specific skills, math activities, and suggested activities are listed. The appendices make up more than half the document and contain advice for the teacher on how to teach the course, occupational information that the teacher can share with students, formulas related to the course, lists of equipment, design notes on special equipment, and information on industrial arts student fair competitions. (CML)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED311225

CURRICULUM DEVELOPMENT

STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

PRINCIPLES OF TECHNOLOGY

BULLETIN 1812

1987

BEST COPY AVAILABLE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

L. Ledbetter

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Issued by

Office of Vocational Education
and
Office of Academic Programs

Wilmer S. Cody, Ed.D.
State Superintendent

CE053210

BEST COPY AVAILABLE

EQUAL OPPORTUNITY STATEMENT

In compliance with Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973, this Educational Agency upholds the following policy:

THIS IS AN EQUAL OPPORTUNITY INSTITUTION AND IS DEDICATED TO A POLICY OF NONDISCRIMINATION IN EMPLOYMENT OR TRAINING. QUALIFIED STUDENTS, APPLICANTS OR EMPLOYEES WILL NOT BE EXCLUDED FROM ANY COURSE OR ACTIVITY BECAUSE OF AGE, RACE, CREED, COLOR, SEX, RELIGION, NATIONAL ORIGIN OR QUALIFIED HANDICAP. ALL STUDENTS HAVE EQUAL RIGHTS TO COUNSELING AND TRAINING.

This public document was published at a total cost of $15,761. 2,000 copies of this public document were published in this 1st printing at a cost of $15,761. The total cost of all printings of this document, including reprints is $15,761. This document was published by the Louisiana Department of Education, Office of Vocational Education, Post Office Box 94064, Baton Rouge, Louisiana 70804-9064 for the dissemination of vocational education curriculum materials for new and changing occupational fields under authority of Public Law 98-524. This material was printed in accordance with the standards for printing by state agencies established pursuant to R.S. 43:31.

STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

Principles of Technology

Curriculum Guide

Bulletin 1812

1987

Issued by

Office of Vocational Education

Don Wood
Assistant Superintendent

Wilmer S. Cody, Ed.D.
State Superintendent

TABLE OF CONTENTS

Foreword. iii

Acknowledgments iv

Louisiana State Board of Elementary and Secondary Education v

Members of Curriculum Writing Team. vi

Rationale vii

How to Use This Curriculum Guide. viii

Goals for Industrial Arts/Technology Education. x

Goals for Teaching Science. xii

Primary Process Skills. xiv

Content Outline 1

Unit 1 Force. 3

Unit 2 Work 12

Unit 3 Rate 20

Unit 4 Resistance 29

Unit 5 Energy 39

Unit 6 Power. 48

Unit 7 Force Transformers 56

Appendix A To the Teachers. 64

Appendix B Occupational Information Guide 65

Appendix C Overview of Principles of Technology 66

Appendix D Resources. 67

Appendix E Principles of Technology: Equipment List. 76

Appendix F Project Fairs. 77

LOUISIANA STATE BOARD
OF ELEMENTARY AND SECONDARY EDUCATION

Mr. Milton Hamel
President
Fourth Congressional District

Dr. Claire R. Landry
Vice-President
First Congressional District

Mrs. Marie Louise Snellings
Secretary-Treasurer
Fifth Congressional District

Mr. Jesse H. Bankston
Sixth Congressional District

Dr. John A. Bertrand
Seventh Congressional District

Bro. Felician Fourrier, S.C.
Member-at-Large

Mrs. Gloria J. Harrison
Member-at-Large

Mrs. Martha Scott Henry
Member-at-Large

Rev. Lionel Johnson
Eighth Congressional District

Mr. Keith Johnson
Second Congressional District

Mr. Jack Pellegrin
Third Congressional District

EXECUTIVE DIRECTOR

Dr. James Meza, Jr.
Room 104, Education Building
P. O. Box 94064, Capitol Station
Baton Rouge, Louisiana 70804-9064

CURRICULUM WRITING COMMITTEE

Ricky Hollier
Gueydan High School
Gueydan, Louisiana

Bob Kennedy
Caddo Magnet High School
Shreveport, Louisiana

George R. Howe, Jr.
Belle Chasse High School
Belle Chasse, Louisiana

Barry Quirk
Belle Chasse High School
Belle Chasse, Louisiana

Bill Bischoff
L. W. Higgins High School
Gretna, Louisiana

Kevin L. Rumple
Donaldsonville High School
Donaldsonville, Louisiana

Raymond P. Cassimere
Plaisance High School
Opelousas, Louisiana

Arthur Talbot
Ellender Memorial Junior High School
Houma, Louisiana

RATIONALE

Developments in science and technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science. Because of the impact of science and technology on our social, economic, and political institutions, the education of every responsible citizen must include not only the basic principles of science but also the attitudes and processes of scientific thought.

The nature of science itself determines the way that it should be taught. The definition of science is a twofold one: It is (1) an unending method or process of seeking new knowledge to answer questions of mechanisms but not purposes, and (2) the body of knowledge which results from this search. Science is an active intellectual process which involves an investigator of any age and something to investigate. It is limited to inquiries of observable physical and social realities. Technology is the application of science to the solution of practical problems. Technology is driven by science; and technology, in turn, influences science.

The discipline of science taught by the process approach teaches the student how to learn, and that intellectual gain is a permanent one for the student. Some students develop thinking skills in the normal course of growing up in a complex world, but the acquisition of useful skills and attitudes is by no means automatic. Many students succeed in school by repeating what they are told in a slightly different form or by memorizing; such strategies are of little extended value. At present, relatively few students develop persistence in and zest for dealing with new concepts because they are not aware of their intellectual capabilities; thus, students need literally to experience the application of skills in scientific processes in different situations.

To be most effective, methods of both science instruction and industrial arts/technology education must be based upon the development of skills in critical thinking. Guided practice in experimenting, observing, gathering information, organizing facts, and drawing conclusions will help to develop critical thinking skills. Laboratory techniques should be employed whenever possible, and inquiry teaching/learning situations using both deductive and inductive reasoning should be the predominant method used in all classroom activities. The teacher's role in a process-oriented science or industrial arts/technology classroom includes being a provider of problems, a discussion leader, a supplier of clues (when necessary), and a skillful questioner, i.e., a facilitator of learning activities. Thus, the aim of an effective science program should be to equip each child with competencies in the basic processes and concepts of science through individual participation in activities and investigations specifically designed to develop such capabilities. Likewise, the aim of an effective industrial arts/technology education program should be to equip each student with the knowledge and appreciation of the importance of technology and of the safe and efficient application of tools, materials, and technological concepts. Industrial arts/technology education should help the student deal with the forces that influence the future, adjust to the changing environment, become a wiser consumer, and make informed career choices.

HOW TO USE THIS CURRICULUM GUIDE

The Principles of Technology Curriculum Guide contains the minimum competencies and skills which should be taught in this course. Also the guide contains suggested activities designed to assist the teacher in presenting each competency; however, the teacher and the students should not be limited to these activities, nor bound to use all of them. Each teacher should build on the foundation of these minimum competencies to establish the maximum program possible for his/her students using the teacher's guide which accompanies the textbook.

Developments in science and technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science through its manifestation in technological developments. The writers of this guide have attempted to produce an instrument which merges scientific theories and laws with technological skills, a combination which should prepare students for vocations requiring such knowledge and skills or for advanced academic training in science and technology.

Principles of Technology is organized into seven sequential units: Force, Work, Rate, Resistance, Energy, Power, and Force Transformers. It is important that the sequential nature of the course, as presented herein, be preserved if maximum benefit is to be realized from the course. The average unit will require the equivalent of twenty-six fifty-minute class periods. The usual division of these periods will be:

- unit overview class and unit summary class, with readings, video presentations, discussions, and unit test.
- eight class discussions that include reading assignments (four based on sub-unit video segments and four based on hardware demonstrations).
- four "problem-solving" math labs.
- eight hands-on physics labs emphasizing the scientific method.
- four review periods (repeating the use of the four sub-unit video segments).

A more detailed discussion of the approaches to teaching Principles of Technology is found in the appendix to this guide.

This course is designed to be taught by teachers with certification in Industrial Arts and/or Physical Sciences (Physical Science-Physics). It is suggested that a team-teaching approach be used during at least the first year of implementation in each school. It is also suggested that science teachers present lectures

and demonstrations related to the principles of mathematics, physics, and industrial arts. When using the team teaching approach with this guide, science teachers should be responsible for teaching specific skills and math activities, while Industrial Arts teachers should be responsible for Suggested Activities. The teachers should conduct hands-on labs. Team teaching is most successful when the two teachers sit in on each other's classes. Release time during the first year of instruction will be required for the teachers to get labs organized and lesson plans prepared. Since the success of this course is highly dependent on lab activities, it is strongly recommended that the equipment and materials listed in Appendix E of this guide be purchased before implementation of this course.

An understanding of the instructional system which is presented in this guide is required before attempting to teach the course.

Like any other curriculum, this one is easiest to implement under the conditions for which it was designed. Basically, one has three tools with which to do this teaching job:

1. The student text, systematically divided into seven units. Each unit covers one technical concept. Each sub-unit explains the concept and how it applies in one of the four energy systems. Each rectangular symbol represents 50 minutes of instruction. Most units require 26 sessions. The first two sessions (C1 and C2) of the sub-unit include the video presentation and lecture/discussions; the third (M) is the math lab; the next two (L1 and L2) are hands-on labs. The sixth session (R) is a review of the material.

2. The video. Video segments provide direct instruction about the principles and systems, thereby introducing and explaining the ideas presented in the text. It is suggested that the teacher take the students to workplace settings where technicians are employed in order to help put variety in the course.

3. The teacher's guide. This portion of the learning package gives suggestions for teaching the class on a page-by-page basis.

   One should keep in mind that the teacher's guide is not a set of rigid rules. It cannot substitute for the teacher's ingenuity and creativity in teaching this class.

A detailed teaching schedule for each unit of instruction which is coordinated with this curriculum guide will be found in Section T-16 of Appendix A.

The writers of this guide have endeavored to provide a concise, well-organized course description which will help make the course presentation a rewarding experience for both the teacher and the students.

GOALS FOR INDUSTRIAL ARTS/TECHNOLOGY EDUCATION

In providing a sound program of industrial arts/technology education for Louisiana's schools, clear goals are essential to serve as program guides. While the overriding goal of industrial arts is to assist students in developing toward successful adulthood through the development of their socio-economic awareness, their interests, their abilities, and their understanding of industry and technology and their potential as citizens, other supporting goals are listed below:

1. To develop in each student an understanding of industry and the free enterprise system and their relationship to society through a coordinated program of study focusing on the principles and practices of industry.

2. To assist students in developing their talents, aptitudes, interests, and potentials as a part of the school's responsibility to assist each student in developing to his/her fullest potential.

3. To develop in each student an understanding of industrial processes and the practical application of scientific principles.

4. To develop problem-solving abilities related to the materials, processes, and products of industry. The problem-solving approach as applied in industrial arts/technology education involves creative thinking and gives the student an opportunity to apply principles and processes of the scientific method, along with supporting activities, to the solution of problems.

5. To develop in each student skills in the proper and safe use of the tools, materials, and machines common to industrial processes. These skills are acquired through planning, construction, and production activities centered around industrial-technical processes and products.

6. To develop in students attitudes toward career opportunities that will enhance their chances of success as they progress through the career preparation process. Students should be prepared to make informed career decisions resulting in satisfactory and rewarding job selection.

Depending on their content and focus, these six goals are applicable to all grade levels (K-12) and to adult programs and to all segments of the student population, including but not limited to the gifted, the slow learner, and the handicapped. These goals are consistent with and supportive of the roles identified for industrial arts in Title II of PL98-524, The Carl Perkins Act of 1984.

GOALS FOR SENIOR HIGH SCHOOL

Industrial arts/technology education programs should be an articulated set of offerings in both vertical and horizontal directions. This will ensure reasonable content progression and program focus.

Industrial arts/technology education at the senior high school level provides concentrated and somewhat specialized technical courses designed to meet the industrially-related consumer needs of secondary students, as well as preparing students for enrollment in advanced vocational-technical programs. High school programs may use combinations of general and unit organization as a part of their delivery system. At this level, elective options are important because they help students to expand their career awareness, technological literacy, consumer skills, and skills and knowledges related to the world of work. Such options play a significant role in assisting students in making job-related decisions as they progress through the formal education system. Students in the upper grades evidence a wide range of interests, abilities, and life goals. With this in mind, designers of industrial arts/technology education programs must provide courses that attempt to address the widest possible range of the students' needs and interests. In the industrial arts/technology education program, not all students will study the same depth or type of content. For example, courses and content may be tailored to a student who will find it necessary to exit school prior to the normal completion time or who may be involved in advanced vocational-technical training as a portion of the regular high school program. Industrial arts/technology education at the high school level will address the following types of student needs:

1. To provide basic instruction for: (a) the elective student who seeks to explore more deeply the avocational, cultural, and consumer aspects of American industry, (b) those students who will pursue advanced education in areas of vocational, technical, industrial education, and the applied sciences, and (c) the reluctant learner, the prospective dropout, the culturally unique, and those students who may be entering the labor force either prior to normal graduation or immediately thereafter.

2. To provide the students with practical and realistic learning situations that simulate the world of industrial work.

3. To develop in all students those attitudes and attributes that will assist them in becoming productive members of society.

Science Literacy

The primary goal of science courses in grades K-12 is to promote science literacy. Before determining what should be taught, science literacy should be defined. Science literacy is the ability to perceive, comprehend, interpret, explain, and predict natural phenomena and to demonstrate such ability technologically. Many science educators recommend that science literacy should be not a separate entity but an integral component of the total curriculum. The perception, comprehension, interpretation, explanation, and prediction of a phenomenon should be fused into every area of the curriculum.

According to most science educators, a scientifically literate citizen should be:

1. aware that science is concerned with the empirical universe.
2. able to read accounts of developments by the scientific community.
3. aware that knowledge developed in the scientific community is probable rather than absolute.
4. aware of the difference between theoretical and empirical concepts and laws.
5. aware of how both empirical and theoretical concepts and laws come into being.
6. aware of the scientifically accepted regulatory principles.
7. aware that theoretical and empirical laws may be descriptive, comparative, or quantitative.
8. able to use theoretical laws in unifying empirical laws.
9. able to use empirical concepts and laws in a constant adjustment to the environment.
10. able to explain and to predict events in the environment in a rational manner.
11. able to translate experience of the natural world into knowledge.
12. able to communicate with other citizens about knowledge and ideas about natural objects and phenomena.
13. able to communicate with other citizens about the use or control of natural objects or forces.

Specific Goals

Achieving science literacy involves attitudes, process skills, concepts, and social aspects of science and technology. This literacy is linked to a global awareness that knowledge is increasing at a tremendous rate and that this rapid increase affects society in a great variety of ways. Based upon this belief, the following major goals of science are stated:

1. Fostering Positive Attitudes Toward Science and the Scientific Process

Developing a deep appreciation of the role of science and the scientific process will influence the way students think about the environment and about their effect on the environment.

2. Developing Process Skills

The development of process skills is an integral part of science activities for students. Students should be given opportunities to develop those intellectual processes of inquiry and thought by which scientific phenomena are explained, measured, predicted, organized, and communicated. These experiences will serve to reinforce scientific concepts.

Basic Scientific Process Skills used in solving problems and making decisions include observing, inferring, classifying, using numbers, measuring, using space-time relationships, communicating, predicting, and designing experiments. Integrated Process Skills include controlling variables, defining operationally, formulating hypotheses, interpreting data, and experimenting.

3. Acquiring Knowledge

Included in the basic science curriculum are those scientific concepts, principles, theories, and laws that will enable the students to understand and interpret natural phenomena. Applying scientific concepts, principles, theories, and laws requires the understanding of cause-effect relationships; energy-matter relationships; time-space relationships; revolutionary, evolutionary, or catastrophic change; interaction of variables; systems; symmetry; and equilibrium.

4. Recognizing the Interaction of Science, Technology, and Society

The students should (a) understand the interrelationships of science, technology, and social and economic development, (b) recognize both the limitations and the usefulness of science and technology in advancing human welfare, and (c) understand the concept of global ethics when new technologies are used. Science and technology are difficult to separate because scientists often develop new technology and new technology produces new avenues for scientists to obtain new knowledge. Changes in science and technology may not always improve society and may be the subject of moral, religious, and/or ethical questions. Such controversial issues cannot be solved in a science classroom but may be discussed.

Within the framework of the science classroom, nine basic process skills are stressed: (1) observing, (2) inferring, (3) classifying, (4) recognizing number relations, (5) measuring, (6) recognizing space-time relationships, (7) communicating, (8) predicting, and (9) decision making. There is a progressive intellectual development with each process. A brief description of each basic process follows:

OBSERVING

Observing is the use of one or more of the five senses to perceive properties of objects or events as they are. Statements about observations should be (1) quantitative where possible, (2) descriptive regarding change(s) and rates of change(s), and (3) free of interpretations, assumptions, or inferences.

INFERRING

Inferring is making statements about objects or events based on observations which are not the result of direct perception. Inferences may or may not be accurate interpretations or explanations of observations. Inferences are based on (1) observation, (2) reasoning, and (3) past experience of the observer. Inferences require evaluations and judgment. Inferences based on one set of observations may suggest further observation which in turn requires modification of original inferences. Inferences lead to predictions.

CLASSIFYING

Classifying is the grouping or ordering of phenomena according to an established scheme. Objects and events may be classified on the basis of observations. Classification schemes are based on observable similarities and differences in arbitrarily selected properties. Classification keys are used to place items within a scheme as well as to retrieve information from a scheme.

RECOGNIZING NUMBER RELATIONS

Finding qualitative relationships is not adequate when solving problems. Quantitative relationships among data with symbols assigned to describe them are necessary.

MEASURING

RECOGNIZING SPACE/TIME

Recognizing space-time relationships is the process that develops skills in the description of spatial relationships and their changes with time. It includes the study of shapes, time, direction, spatial arrangement, symmetry, motion, and rate of change.

COMMUNICATING

Communicating is to pass information from one person to another. Communications may be oral, nonverbal (e.g., gestures), written, or pictorial (pictures, maps, charts, and graphs). Communications should be concise, accurate, clear, and precise descriptions of what is perceived.

PREDICTING

Predicting is forecasting what future observations might be; it is closely related to observing, inferring, and classifying. The reliability of predictions depends upon the accuracy of past and present observations and upon the nature of the event being predicted.

DECISION-MAKING SKILLS

Decision-making skills are based on evaluation and synthesis. Decision-making is one link from science to other areas of the curriculum. Value judgments generally should be based on accurate information obtained scientifically. Evaluation implies value judgment based on many factors. Within the framework of environmental science, many evaluations must be made. Decisions, especially those having social, political, or economic consequences, are seldom made with only scientific considerations.

As basic progressive, intellectual development proceeds in each process skill, the interrelated nature of the processes is manifested in the five integrated processes: (1) controlling variables, (2) defining operationally, (3) formulating hypotheses, (4) interpreting data, and (5) experimenting. A brief description of each integrated process follows:

CONTROLLING VARIABLES TO ANALYZE SYSTEMS AND FORMULATE MODELS

A variable is any factor in a situation that may change or vary. Investigators in science and other disciplines try to determine what variables influence the behavior of a system by manipulating one variable, called the manipulated (independent) variable, and measuring its effect on another variable, called the responding (dependent) variable. As this is done, all other variables are held constant. If there is a change in only one variable and an effect is produced on another variable, the investigator can conclude that the effect has been brought about by the changes in the manipulated variable. If more than one variable changes, there can be no certainty at all about which of the changing variables causes the effect on the responding variable.

DEFINING OPERATIONALLY BY GATHERING AND PROCESSING INFORMATION

To define operationally is to choose a procedure for measuring a variable. In a scientific investigation, measurements of the variables are made; however, the investigator must decide how to measure each variable. An operational definition of a variable is a definition determined by the investigator for the purpose of measuring the variable during an investigation; thus, different operational definitions of the same variable may be used by different investigators.

FORMULATING AND USING DEDUCTIVE-NORMATIVE EXPLANATIONS

To formulate a hypothesis is to make a guess about the relationships between variables. A hypothesis is usually stated before any sensible investigation or experiment is performed because the hypothesis provides guidance to an investigator about the data to collect. A hypothesis is an expression of what the investigator thinks will be the effect of the manipulated variable on the responding variable. A workable hypothesis is stated in such a way that, upon testing, its credibility can be established.

INTERPRETING AND COMMUNICATING SCIENTIFIC INFORMATION

The process of interpreting data may include many behaviors such as (1) recording data in a table, (2) constructing bar or line graphs, (3) making and interpreting frequency distributions, (4) determining the median, mode, and range of a set of data, (5) using slope or analytical equations to interpret graphs, and (6) constructing number sentences describing relationships between two variables. Interpreting data requires going beyond the use of the skills of tabulating, charting, and graphing to ask questions about the data which lead to the construction of inferences and hypotheses. Interpretations are always subject to revision in the light of new or more refined data.

EXPERIMENTING USING INTEGRATED PROCESS SKILLS

Experimenting is the process of designing a procedure that incorporates both the basic and the integrated process skills. An experiment may begin as a question for the purpose of testing a hypothesis. The basic components of experimenting are:

1. Constructing a hypothesis based on a set of data collected by the investigator from observations and inferences.
2. Testing the hypothesis. The variables must be identified and controlled as much as possible. Data must be collected and recorded.
3. Describing or interpreting how the data support or do not support the hypothesis in order to determine whether the hypothesis is to be accepted, modified, or rejected.
4. Constructing a revised hypothesis if the data do not support the hypothesis.

CONTENT OUTLINE

UNIT 1: FORCE

- Force in Mechanical Systems
- Pressure in Fluid Systems
- Voltage in Electrical Systems
- Temperature in Thermal Systems
- Occupations in Force-Related Fields

UNIT 2: WORK

- Work in Mechanical Systems
- Work in Fluid Systems
- Work in Electrical Systems
- Occupations in Work-Related Fields

UNIT 3: RATE

- Rate in Mechanical Systems
- Rate in Fluid Systems
- Rate in Electrical Systems
- Rate in Thermal Systems
- Occupations in Rate-Related Fields

UNIT 4: RESISTANCE

- Resistance in Mechanical Systems
- Resistance in Fluid Systems
- Resistance in Electrical Systems
- Resistance in Thermal Systems
- Occupations in Resistance-Related Fields

UNIT 5: ENERGY

Energy in Mechanical and Fluid Systems I
Energy in Mechanical and Fluid Systems II
Energy in Electrical Systems
Energy in Thermal Systems
Kinetic Energy in Mechanical and Fluid Systems
Occupations in Energy-Related Systems

UNIT 6: POWER

Power in Mechanical Systems
Power in Fluid Systems
Power in Electrical Systems
Power in Thermal Systems
Occupations in Power-Related Systems

UNIT 7: FORCE TRANSFORMERS

Force Transformers in Linear Mechanical Systems
Force Transformers in Rotational Mechanical Systems
Force Transformers in Fluid Systems
Force Transformers in Electrical Systems
Occupations in Technical Fields Using Force Transformers

UNIT I FORCE

OVERVIEW: FORCE

UNIT OBJECTIVES:

The student will:

Identify the four energy systems.

Relate force to the four energy systems.

Recognize the existence and effect of balanced and unbalanced forces.

LEARNING ACTIVITIES

1. Read pages 1-5

2. View and discuss video "Overview: Force."

3. List and give examples of each energy system:

   A. Mechanical
      Demonstrate arm wrestling

   B. Fluid
      (1) Check for pulse (heartbeat)
      (2) Fill a balloon with air/water
      (3) Demonstrate hydraulic jack

   C. Electrical
      Increase the number of batteries to increase the intensity of the light

   D. Thermal
      (1) Conduct teacher demonstration on p. D-15
      (2) Pop popcorn
      (3) Boil water, then add ice

UNIT I FORCE

Concept: Definition of Force

Objective I. The student will define and describe force as it relates to mechanical, fluid, electrical, and thermal systems.

Concept: Measurements of force in energy systems

Objective II. The student will measure and solve problems based upon the results of force measurements for energy systems.

Concept: Occupations in force-related technical fields

Objective III. The student will relate the concept of force to occupations in technical fields.

CONCEPT: Definition of Force

OBJECTIVE I: The student will define and describe force as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Force in Mechanical Systems		
A. Describe unbalanced forces as being able to change the speed, direction, or shape of an object by means of a push or pull.		- Text, p. 3 - View and discuss video "Force in Mechanical Systems."
B. Define torque as the product of a force and lever arm which tends to produce rotation.		- Demonstration 1DM, Torque, pp. D-3, D-4
II. Pressure in Fluid Systems		
A. Define pressure. Identify it as a vector or scalar quantity.	Lab 1MS1, p. 23	- Text, pp. 44-50 - Lab 1F2, Measuring Pressure, p. 63 - Demonstration 1DF, Pressure, p. D-7
B. Explain atmospheric pressure.		- Lab 1F2, Measuring Pressure, p. 63
III. Voltage in Electrical Systems		
A. Differentiate between AC and DC current.		- Lab 1E2, Electrical Circuit, p. 87 - Text, pp. 72-73
B. Describe how voltage is a force-like quantity.		- Lab 1DE, Electrical Force, p. D-11 - Lab 1E1, Measuring Voltage, p. 83

CONCEPT: Definition of Force

OBJECTIVE 1: The student will define and describe force as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
C. Describe how frequency relates to alternating current.		- Text, p. 74
IV. Temperature in Thermal Systems		
Define temperature difference as a prime mover in a thermal system.		- Demonstration 1DT, Temperature Difference, p. D-15

CONCEPT: Measurements of Force in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of force measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Force in Mechanical Systems		
A. Measure scalar and vector quantities using appropriate instruments and units.	Activity #1, Lab 1MS1, p. 24	- Lab 1M2, Mechanical Stress: Its Cause and Effect, p. 37
B. Use scale diagrams to determine the resultant, given two or more vectors.	Activity #2, Lab 1MS1, p. 26	- Lab 1M1, Measuring Forces, p. 31
C. Calculate torque, given the values for force and lever arm length.	Activity #3, Lab 1MS1, p. 29	- Torque 3 bolts to specified values using a torque wrench.

CONCEPT: Measurements of Force in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of force measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
II. Pressure in Fluid Systems		
A. Solve problems for density and specific gravity.	Activity #1, Lab IMS 2, p. 55	- Text, pp. 44-45 - Lab 1F1, Specific Gravity, p. 59 - Student exercises pp. 53, 54
B. Use the formulas P=F/A and P=ph, to solve problems for force, pressure, or area in a fluid system.	Lab IMS 2, p. 55	- Text pp. 46-53 - Lab 1F2, Measuring Pressure, p. 87
III. Voltage in Electrical System		
A. Use various voltmeters to measure voltage.		- Lab 3E1, Measuring Current, p. 81 - Lab 1E1, Measuring Voltage, p. 83 - Lab 1E2, Electrical Circuit, p. 87 - Suggested text material, pp. 75-76

CONCEPT: Measurements of Force in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of force measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
IV. <u>Temperature in Thermal Systems</u>		
A. Read and record temperature on "F" and "C" scales.	Lab 1MS4, p. 99	- Text, p. 94
B. Convert temperatures from "F" to "C", "C" to "F".		- Lab 1T1, Measuring Temperature with Thermometer, p. 103 - Text, pp. 94-95
C. Measure temperature using a thermocouple.		- Lab 1T2, Measuring Temperature with Thermocouple, p. 107 - Text, p. 96

CONCEPT: Occupations in Force-Related Technical Fields

OBJECTIVE III: The student will relate the concept of force to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Occupations in Force-Related Fields		
Research and list occupations that require technicians to measure, control, or otherwise deal with force, pressure, voltage, and temperature in complex devices.		- Invite guest speaker. - Conduct a field trip. - View and discuss unit videos. - Write a research paper related to a particular career. - Consult Principles of Technology Occupational Information Appendix B. - Prepare oral report. - Interview an individual who works in a field that requires the basic knowledge required in this unit.

SUMMARY OF UNIT 1 FORCE

OBJECTIVE: The student will:

Summarize and discuss the principles of force as they apply to the energy system.

Learning Activities

1. Read the summary of Unit 1 Force, pp. 113-114.
2. View and discuss video "Summary: Force."
3. Review current occupations related to force.
4. Administer unit test.

UNIT 2 WORK

OVERVIEW: WORK

UNIT OBJECTIVES

The student will:

Define and describe work as a result of force causing change in a system.

Measure and solve problems based upon the results of work measurements for energy systems.

Relate the concept of work to occupations in technical fields.

Learning Activities

1. Read pages 1-6
2. View and discuss the video, "Overview: Work."
3. List and give examples of each energy system:

   A. Mechanical
      (1) open and close a door (rotational)
      (2) move an object from one place to another (linear)

   B. Fluid
      (1) brake system
      (2) syringe
      (3) air shocks of auto
      (4) inflating a tire

   C. Electrical
      (1) hand generator and/or bicycle generator
      (2) voltmeter

U N I T 2 W O R K

CONCEPT: Definition of Work

OBJECTIVE I: The student will define and describe work as it relates to mechanical, fluid, and electrical systems.

CONCEPT: Measurements of work in energy systems

OBJECTIVE II: The student will measure and solve problems based upon the results of work measurements for energy systems.

CONCEPT: Occupations in work-related technical fields

OBJECTIVE III: The student will relate the concept of work to occupations in technical fields.

CONCEPT: Definition of Work

OBJECTIVE I: The student will define and describe work as it relates to mechanical, fluid, and electrical systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Work in Mechanical Systems		
A. Define work in a linear mechanical system as the product of applied force times the distance an object moves.		- Pre-video activity, p. T7-C - View and discuss video "Work in Mechanical Systems."
B. Define work in a rotational mechanical system as the product of applied torque and the angle in radians an object moves through.		- Demonstrate rotational work using a torque wrench.
C. Define efficiency in terms of work input and work output.		- Read and discuss work and efficiency as presented on page 11 of the text.
II. Work in Fluid Systems		
A. Identify and describe what is meant by work done in a fluid system.		- Demonstration 2DF, Fluid Work, p. D-7 - Text, pp. 36-65
B. Describe how open and closed fluid systems are different.		- Text, pp. 36-37, fig. 2-10 Lab 2F1, Work Done by a Piston, p. 49

CONCEPT: Definition of Work

OBJECTIVE I: The student will define and describe work as it relates to mechanical, fluid, and electrical systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Work in Electrical Systems		
A. Explain the meaning of voltage.		- Review and discuss video "Work in Electrical Systems."
B. Describe charge as it relates to work.		- Text, pp. 66-67

CONCEPT: Measurements of Work in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of work measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Work in Mechanical Systems		
Calculate work and efficiency in both linear and rotational systems.	Lab 2MS1, p. 17	- Lab 2M1, Linear Work and Efficiency, p. 21 - Lab 2M2, Rotational Work and Efficiency, p. 27
II. Work in Fluid Systems		
A. Explain the relationship between work and pressure difference in a fluid system: Work=pressure difference x fluid volume moved. Work=pressure x change in volume.		- Lab, 2F2, Work Done By a Water Pump, p. 57
B. Solve work problems (given pressure and volume information) in English and SI Units.	Lab 2MS2, p. 45	- Student Exercises, pp. 43-44

55

56

CONCEPT: Measurements of Work in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of work measurements for energy sytems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Work in Electrical Systems		
A. Define coulomb as a unit of charge.	Activity #1, Lab 2MS3, p. 75	- Text, p. 67
B. Use a multimeter to perform measurements in an electrical system.	Activity #2, Lab 2MS3, p. 75	
C. Solve electrical work problems, given voltage and charge information using W = Vg.		
D. Explain how efficiency relates to an electrical system.		- Lab 2E1 ,Work Done by a Motor, pp. 79-80 - Lab 2E2, Work Done by a Solenoid, pp. 85-89

57

58

CONCEPT: Occupations in Work-Related Technical Systems

OBJECTIVE III: The student will relate the concept of work to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Occupations in Work-Related Fields Research and list occupations that require technicians to measure, control, or otherwise deal with force, pressure, voltage, and temperature in complex devices.		- Invite guest speaker and/or conduct field trip. - View and discuss unit videos. - Write research paper. - Consult Principles of Technology Occupation Information Appendix B. - Prepare oral report.

SUMMARY OF UNIT 2 WORK

OBJECTIVE: The student will:

Summarize and discuss the principles or work as they apply to the energy systems.

Apply the general formula for work in mechanical, fluid, and electrical energy systems.

Learning Activities

1. Read the summary of Unit 2, "Work," pp. 91-92.
2. View and discuss video "Summary: Work."
3. Review work equations using teacher examples.
4. Review current occupations related to work.
5. Administer unit test.

UNIT 3 RATE

OVERVIEW: RATE

°UNIT OBJECTIVES

The student will:

Define and describe rate as movement per unit of time.

Define and describe rate as it relates to mechanical, fluid, electrical, and thermal systems.

Measure and solve problems based upon the results of rate measurements for energy systems.

Relate the concept of rate to occupations in technical fields.

Learning Activities

1. Read pages 1-5.
2. View and discuss the video "Overview: Rate."
3. List and give example of rate in energy systems.

   A. Mechanical
      (1) heart rate
      (2) walking rate
      (3) odometer
      (4) metronome

   B. Fluid
      (1) gasoline pump
      (2) aquarium pump

   C. Electrical
      (1) watt hour meter
      (2) ammeter

   D. Thermal
      (1) thermometer
      (2) toaster
      (3) wood burner
      (4) thermostat
      (5) Home furnace and air conditioner BTU rating

UNIT 3 RATE

CONCEPT: Definition of Rate

OBJECTIVE I: The student will define and describe rate as it relates to mechanical, fluid, electrical, and thermal systems.

CONCEPT: Measurement of rate in energy systems

OBJECTIVE II: The student will measure and solve problems based upon the results of rate measurements for energy systems.

CONCEPT: Occupations in rate-related technical fields

OBJECTIVE III: The student will relate the concept of rate to occupations in technical fields.

CONCEPT: Definition of Rate

OBJECTIVE 1: The student will define and describe rate as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Rate in Mechanical Systems		
A. Define linear rate as displacement per unit of time and recognize it as either a scalar or vector quantity.		- Text p. 8 - View and discuss video, "Rate I Mechanical Systems."
B. Define rotational rate as angular displacement per unit of time.		- Text, p. 13 - Demonstration 3-0M, Mechanical Rate, p. 0-3
C. Recognize linear acceleration as the change in speed per unit of time.		- Text, pp. 10-11
II. Rate in Fluid Systems		
Define and describe rate in a fluid system.		- Lab 3F1, Measuring Liquid Flow Rate in a Channel, p. 5 - Text, pp. 35-40 - LAB 3F2, Measuring Gas Flow Rates with an Orifice, p. 53

CONCEPT: Definition of Rate

OBJECTIVE I: The student will define and describe rate as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Rate in Electrical Systems		
A. Explain the meaning of rate and ampere in electrical current.		- Text, pp. 40-41 - View video, "Rate in Electrical System."
B. Define and explain the relationship between frequency and period.		- Text, pp. 64-66
C. Distinguish between DC and AC current.		- Use a galvanometer.
IV. Rate in Thermal Systems		
Define rate as it applies to the flow of heat through a thermal system per unit of time.		- Text, pp. 92-97 - Demonstration, 3DT, p. D 17 - Lab 3T1, Measuring Heat Flow Rate, pp. 109-116 - Lab 3T2, Measuring Cooling Rate, pp. 117-121

CONCEPT: Measurement of Rate in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of rate measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Rate in Mechanical Systems		
A. Determine linear rate using appropriate units.	Example 3-A, p. 9	- Lab 3M1, Measuring Linear Rate on Conveyor Belt, pp. 25-28
B. Determine angular rate using appropriate units.	Example 3-C and 3-D, p. 14	- Lab 3M2, Measuring Angular Rate with a Stroboscope, pp. 29-33
II. Rate in Fluid Systems		
A. Describe a volume flow-rate where (Qv) $Qv = \frac{V}{t}$; and a mass flow-rate (Qm) where $Qm = \frac{M}{t}$	Activity #2, Lab 3MS2, p. 41 Activity #3, Lab 3MS2-3, p. 41	- Demonstration 3DF, Fluid Rate, pp. 7-9
B. Use the fluid rate equations to find an unknown.		- Student exercises, p. 40

CONCEPT: Measurements of Rate and Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of rate measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Rate in Electrical Systems		
A. Use rate equation for current $I = \frac{q}{t}$	Activity #3, Lab 3MS3, pp. 77-79	- Lab 3E1, Measuring Current, pp. 81-84
B. Frequency formula $f = \frac{n}{t}$	Activity #2, Lab 3MS3, pp. 73-76	- Lab 3E2, Measuring Frequency, pp. 87-90
C. Period formula $T = \frac{1}{f}$	Activity #1, Lab 3MS3, pp. 70-72	- Lab 3E2, Measuring Frequency, pp. 87-90
D. Compare frequency of AC and DC.		- Use oscilloscope.

CONCEPT: Measurements of Rate and Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of rate measurements for energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
IV. Rate in Thermal System		
A. Measure and define heat/rate in thermal systems using both English and SI units.	Activity #1 and #2, Lab 3MS4, p. 103-108	- Text, p. 94
B. Describe how specific heat and heat capacity relate to each other.		
C. Describe how sensible heat and latent heat relate to each other.		- Text, p. 98

CONCEPT: Occupations in Rate-Related Technical Fields

OBJECTIVE III: The student will relate the concept of rate to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Occupations in Rate-Related Fields		
Research and list occupations that require technicians to measure, control, or otherwise deal with rate in energy systems.		- Invite a guest speaker and/or conduct field trip. - View and discuss unit videos. - Write research paper. - Consult Principles of Technology Occupation Information Appendix B. - Prepare oral report.

SUMMARY OF UNIT 3 RATE

OBJECTIVE: The student will:

Summarize and discuss the principles of rate as they apply to the energy systems.

Apply the general formula for rate in mechanical, fluid, electrical, and thermal energy systems.

Learning Activities

1. Read summary of Unit 3 Rate, pp. 123-124.
2. View and discuss video, "Summary: Rate."
3. Review current occupations related to rate.
4. Administer unit test.

UNIT 4 RESISTANCE

OVERVIEW: RESISTANCE

°UNIT OBJECTIVES:

The student will:

Define resistance as it applies to mechanical, fluid, electrical, and thermal systems.

Define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

Measure and solve problems based upon the results of resistance measurements for energy systems.

Relate the concept of resistance to occupations in technical fields.

Learning Activities

1. Read pages 1-6.
2. View and discuss the video "Overview: Resistance."
3. List and give examples of resistance in energy systems.

   A. Mechanical
      (1) parachute
      (2) streamlining vehicles
      (3) tires against road
      (4) rubbing hands together

   B. Fluid
      (1) water valve
      (2) different diameter water hoses

   C. Electrical
      (1) volume on a radio
      (2) different wattage light bulbs
      (3) different wire sizes

   D. Thermal
      (1) thermos bottle
      (2) styrofoam cup
      (3) wearing clothing to prevent heat loss

UNIT 4 RESISTANCE

CONCEPT: Definition of Resistance

OBJECTIVE I: The student will define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

CONCEPT: Measurements of resistance in energy systems

OBJECTIVE II: The student will measure and solve problems based upon the results of resistance measurements in energy systems.

CONCEPT: Occupations in resistance-related technical fields

OBJECTIVE III: The student will relate the concept of resistance to occupations in technical fields.

CONCEPT: Definition of Resistance

OBJECTIVE I: The student will define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Resistance in Mechanical Systems		
A. Define and identify friction as the primary resistance force in mechanical systems.		- Text, p. 8 - View and discuss video, "Resistance in Mechanical Systems."
B. Distinguish between kinetic and static friction.		- Text, p. 9 - Pull a brick with a spring scale demonstrating static and kinetic friction.
C. Describe ways to reduce or increase friction in mechanical systems.		- Lab 4M1, Reducing Friction with Lubricants, pp. 25-29
D. Recognize drag as a form of resistance.		- Text, p. 13 - Drop a flat and a crumpled sheet of paper to show drag. - Hold open hand in front of strong fan in various positions and describe the force on the hand.

CONCEPT: Definition of Resistance

OBJECTIVE I: The student will define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
II. Resistance in Fluid Systems		
A. Describe the nature of resistance in fluid systems.		- Text, pp. 38-39 - Demonstration 4DE, Resistance to Airflow, p. D-7 - View video, "Resistance in Fluid Systems."
B. Identify the sources and effects of resistance for a fluid moving through a pipe.		- Text, pp. 38-39 - Lab 4F1, Measuring Fluid Resistance in Pipes, pp. 51-56
III. Resistance in Electrical Systems		
A. Define resistance and show how it relates to the principle of force divided by time.		- View video, "Resistance in Electrical Systems" - Text, pp. 64-65
B. Define resistivity and show relationship to resistance.		- Text, pp. 66 and 70-71 - Lab demonstration not in text which explores conductors, semiconductors, and insulators
C. Demonstrate that resistance depends on 3 factors: wire length, cross-sectional area, material.		- Text, p. 66 - Demonstration 4DE, Electrical Resistance and Ohm's Law, pp. [illegible]
D. Define resistor and explain the color-coding system.	Lab 4MS3, pp. 76-78	- Text, p. 67 - Lab 4E1, Ohm's Law and Series Circuit, Part B, pp. 85-86

CONCEPT: Definition of Resistance

OBJECTIVE I: The student will define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
E. Describe the difference between resistors in series and parallel circuits.		- Text, p. 67-70
F. Describe the difference between fixed and variable resistors.		- Text, p. 70 - Teacher-made demonstration showing resistors
G. Discuss positive and negative effects of electrical resistance.		- Teacher-made demonstration showing good and bad effects of resistance

CONCEPT: Definition of Resistance

OBJECTIVE I: The student will define and describe resistance as it relates to mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
IV. Resistance in Thermal Systems		
A. Describe the nature and effects of resistance in a thermal system.		- Text, p. 97
B. Define thermal conductivity as it relates to resistance, temperature difference and heat-flow rate.		- Text, pp. 98-99 - Demonstration 4DT, Thermal Resistance, p. D-15.

CONCEPT: Measurements of Resistance in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of resistance measurements in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Resistance in Mechanical Systems		
Solve problems using the relationship between friction, and the force pressing two surfaces together (f=uN).	Lab 4MS1, pp. 19-22	- Lab 4M1, Reducing Friction with Lubricants, pp. 25-29
II. Resistance in Fluid Systems		
A. Use the equation, $Rf = \frac{\Delta p}{QV}$ to calculate an unknown and show that fluid resistance obeys the unifying principle of a "force" divided by rate.	Lab 4MS2, pp. 47-50	
B. Measure fluid resistance in the laboratory, and express it in appropriate units.		- Lab 4F1, Measuring Fluid Resistance in Pipes, pp. 51-56 - Lab 4F2, Measuring Resistance in Air Filters, pp. 57-62 - Sub-unit 2, student exercises, p. 45

CONCEPT: Measurements of Resistance in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of resistance measurements in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Resistance in Electrical Systems		
A. Use the Ohm's Law equation R=V/I to solve for an unknown in correct units.	Examples, pp. 65-67 Activity #2, Lab 4MS3, p. 79	- Text, pp. 65-67
B. Use instruments to determine resistance and current in series circuits.		- Lab 4E1, Ohm's Law and Series Circuits, pp. 81-85
C. Use instruments to determine resistance and current in parallel circuits.		- Lab 4E2, Ohm's Law and Parallel Circuits, pp. 87-93
IV. Resistance in Thermal Systems		
A. Measure and calculate thermal resistance.	Activity #1 and #2, Lab 4MS4, pp. 107-111	- Text, pp. 100-104
B. Define R-factor and how it relates to thermal resistance when it is increased or reduced.		- Lab 4T1, Measuring Resistance of Thermal Insulation, pp. 113-118

90

91

CONCEPT: Occupations in Resistance-Related Technical Fields

OBJECTIVE III: The student will relate the concept of resistance to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Occupations in Resistance-Related Systems		
A. Research and list occupations that require technicians to measure control or otherwise deal with resistance in mechanical, fluid, electrical, and thermal systems.		- Invite guest speaker and/or conduct a field trip. - View and discuss unit videos. - Write research paper. - Consult Principles of Technology Occupation Information Appendix B. - Prepare an oral report.

OBJECTIVE: The student will:

Summarize and discuss the principles of resistance as they apply to the energy systems.

Apply the general formula for resistance in mechanical, fluid, electrical, and thermal energy systems.

Learning Activities

1. Read summary of Unit 4, "Resistance," pp. 127-128.
2. View and discuss video "Summary: Resistance."
3. Review current occupations related to resistance.
4. Administer unit test.

UNIT 5 ENERGY

OVERVIEW: ENERGY

UNIT OBJECTIVES

The student will:

Describe the nature of energy in mechanical, fluid, electrical, and thermal systems.

Describe and explain the relationship between potential energy, kinetic energy, and heat energy in the conservation of energy flow.

Learning Activities

1. Read pp. 1-7.

2. View and discuss video "Overview: Energy."

3. List and give examples of energy systems.

   A. Mechanical/Fluid
      (1) bulldozer
      (2) "mouse trap car"
      (3) avalanche
      (4) parachute
      (5) hang gliders

   B. Electrical
      (1) storage battery (flashlight)
      (2) relay (smoke detector)

   C. Thermal
      (1) hot air balloon
      (2) steam engine
      (3) power plant applications

U N I T 5 E N E R G Y

CONCEPT: Definition of Energy

OBJECTIVE I: The student will define and describe kinetic energy and potential energy as the ability to do work in mechanical, fluid, electrical, and thermal systems.

CONCEPT: Law of Conservation of Energy

OBJECTIVE II: The student will use the law of conservation of energy to describe how one form of energy is changed into another form.

CONCEPT: Measurements of Energy

OBJECTIVE III: The student will measure and solve problems related to energy and its conservation.

CONCEPT: Occupations in Energy Related Technical Fields

OBJECTIVE IV: The student will relate the concept of energy to occupations in technical fields.

CONCEPT: Definition of Energy

OBJECTIVE I: The student will define and describe kinetic energy and potential energy as the ability to do work in mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Energy in Mechanical and Fluid Systems I		
A. Distinguish between gravitational and elastic potential energy.		- Read Text, pp. 9-14 - View and discuss video "Energy in Mechanical and Fluid Systems I." - Modify Lab 5MF1 to demonstrate elastic potential energy of a spring. Omit measurement and calculations at this time. pp. 27-29
II. Energy in Mechanical and Fluid Systems II		
A. Describe what is meant by the moment of inertia (I) of rotating bodies.		- View and discuss video "Energy in Mechanical and Fluid Systems II." - Text, pp. 43-53
B. Measure kinetic energy.		- Lab 5MF4, Measuring the Kinetic Energy of a Rotating Flywheel, pp. 67-72
III. Energy in Electrical Systems		
A. Describe the nature of potential energy in an electrical system.		- Text, p. 76 - View video, "Energy in Electrical Systems."
B. Describe the relationship between work and electrical energy.		- Text, p. 81

CONCEPT: Definition of Energy

OBJECTIVE I: The student will define and describe kinetic energy and potential energy as the ability to do work in mechanical, fluid, electrical, and thermal systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
C. Describe a capacitor and its operation.		- Text, p. 77
D. Describe an inductor and its operation.		- Text, pp. 78-79
E. Discuss efficiency in electrical systems.		
IV. Energy in thermal systems		
Describe thermal energy, its relation to work, and the mechanical equivalent of heat.		- Text, pp. 106-107 - Demonstration 5DT, Changing Fluid Energy to Thermal Energy, pp. D-15 through D-17. - Demonstrate how heat raises objects.

CONCEPT: Law of Conservation of Energy

OBJECTIVE II: The student will use the law of conservation of energy to describe how one form of energy is changed to another form.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Energy in Mechanical and Fluid Systems (One)		
Explain that stored potential energy can be converted to kinetic energy.		- Demonstration 4DM, Changing Potential Energy to Kinetic Energy, pp. D3-D5
II. Kinetic Energy in Mechanical and Fluid Systems (Two)		
A. Describe how one form of energy is changed into another form.		- Demonstration 5DF, Changing Fluid Potential Energy to Kinetic Energy, pp. D-7, D-8
B. Describe the relationship between work and mechanical energy.		- Lab 5MF3, Using Energy in Compressed Air to Operate Air Motors, pp. 63-65
III. Energy in Electrical Systems		
Describe the conversion of fluid energy to electrical energy.		- Lab 5E2, Converting Fluid Energy to Electrical, pp. 99-102
IV. Energy in thermal systems		
A. Describe the role of heat energy in the law of conservation of energy.		- Text, pp. 112-113
B. Describe the effect of heat energy in changing states of matter.		- Text, pp. 111-112 - Change water to different states.

CONCEPT: Measurements of Energy

OBJECTIVE III: The student will measure and solve problems related to energy and its conservation.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Energy in Mechanical and Fluid Systems (One)		
A. Measure the potential energy using the formula $E_p = Wh$ or $E_p = mgh$		- Text, pp. 15-16 - Student exercises, p. 19 - Examples 5-A and 5-B, p. 11
B. Determine spring constant using the formula $K = \frac{F}{d}$	Lab 5MS1, pp. 21-24	- Lab 5MF1, Measuring the Potential Energy of a Spring, pp. 27-33
C. Determine elastic potential of a spring using the formula $E_p = \frac{1}{2}kd^2$	Lab 5MS1, pp. 21-24	- Lab 5MF1, Measuring the Potential Energy of a Spring, pp. 27-33
D. Measure the potential energy in a hydraulic accumulator.		- Lab 5MF2, Energy Stored in a Hydraulic Accumulator, pp. 33-41
II. Energy in Mechanical and Fluid Systems (Two)		
Calculate rotational kinetic energy using the formula, $E_k = \frac{1}{2}Iw^2$	Activity #1 and #2, Lab 5MS2, pp. 57-62	
III. Energy in Electrical Systems		
A. Use the equation $E_p = \frac{1}{2}CV^2$ to calculate the electrical energy stored in a capacitor.	Lab 5MS3, pp. 85-88	- Lab 5E1, Energy Stored in a Capacitor, pp. 91-97 - Demonstration 5DF, Tracking Voltage Change in a Discharging Capacitor, p. D-9

CONCEPT: Measurements of Energy

OBJECTIVE III: The student will measure and solve problems related to energy and its conservation.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
B. Use the equation $E_p = \frac{1}{2}LI^2$ to calculate energy stored in an inductor.	Lab 5MS3, pp. 85-88	- Teacher-made lab
IV. Energy in Thermal Systems		
A. Using the equation $H=mc\Delta T$, describe and measure the three processes of transferring heat energy.	Activity #1 and #2, Lab 5MS4, pp. 117-122	- Text, pp. 109-110 - Lab 5T1, Equilibrium Temperature of a Mixture, pp. 123-126 - Lab 5T2, Thermal Energy and Specific Heat of Metal, pp. 127-130

CONCEPT: Occupations in Energy-Related Technical Fields

OBJECTIVE IV: The student will relate the concept of energy to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Occupations in Energy-Related Technical Fields		
Research and list occupations that require technicians to measure, control or otherwise deal with energy in mechanical, fluid, electrical, and thermal systems.		- Invite guest speaker and/or conduct field trip. - View and discuss unit videos. - Research paper. - Consult Principles of Technology Occupational Information Appendix B - Prepare oral report.

SUMMARY OF UNIT 5 ENERGY

OBJECTIVE: The student will:

Explain the relationship between potential energy and kinetic energy.

Apply the law of conservation of energy.

Summarize and discuss the principles of energy as they apply to mechanical, fluid, electrical, and thermal systems.

Explain the relationship between energy and work.

Learning Activities

1. Read summary of Unit 5, "Energy," pp. 133-135.
2. View and discuss video "Summary: Energy."
3. Review current occupations related to energy.
4. Administer unit test.

113

112

U N I T 6 P O W E R

OVERVIEW: POWER

OBJECTIVES

The student will:

Describe how power relates to work divided by time in mechanical, fluid, and electrical systems.

Explain how thermal power and thermal rate are the same.

Explain power as force times a rate in mechanical, fluid, and electrical systems.

Learning Activities

1. Read pp. 1-5
2. View and discuss video "Overview: Power."
3. List and give examples of energy systems:

   A. Mechanical
      (1) outboard motor
      (2) gas turbine
      (3) water turbine
      (4) crane

   B. Fluid
      (1) jet drive outboards
      (2) water saw
      (3) power washer
      (4) pneumatic tools

   C. Electrical
      (1) generator
      (2) alternator
      (3) amplifier

   D. Thermal
      (1) internal combustion engine
      (2) heat pump
      (3) solar heater

UNIT 6 POWER

CONCEPT: Definition of Power

OBJECTIVE I: The student will define and describe power as it relates to mechanical, fluid, and electrical systems.

CONCEPT: Measurements of power in energy systems

OBJECTIVE II: The student will measure and solve problems based upon the results of power in energy systems.

CONCEPT: Occupations in power-related technical fields

OBJECTIVE III: The student will relate the concept of power to occupations in technical fields.

CONCEPT: Definition of Power

OBJECTIVE I: The student will define and describe power as it relates to mechanical, fluid, and electrical.

SPECIFIC SKILLS	MATE ACTIVITIES	SUGGESTED ACTIVITIES
I. Power in Mechanical Systems		
A. Explain why power in a linear mechanical system can be described either work per unit of time or as force times rate.		- View and discuss video, "Power in Mechanical Systems." - Elaborate on subunit objectives 1 and 2 on p. 7 of the text. - Text, pp. 8-9
B. Explain why power in a rotational mechanical system follows the unifying principle of work per unit of time and force times rate.		- Elaborate on subunit objectives 3 and 4 on p. 7. - Text, pp. 9-10
C. Define efficiency in mechanical systems as output power divided by input power.		- Text, pp. 11-12
II. Power in Fluid Systems		
Define power in a fluid system as work divided by time: $P = \frac{(\Delta p)V}{t}$		- Text, pp. 39-48 - View and discuss video "Power in Fluid Systems." - Class discussion and demonstration, pp. D-5 through D-7.

CONCEPT: Definition of Power

OBJECTIVE I: The student will define and describe power as it relates to mechanical, fluid, and electrical.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
III. Power in Electrical Systems		
A. Define power in an electrical system.		- Text, p. 72 - View the video, "Power in Electrical Systems." - Demonstration, 6DF, Electrical Power Demonstration, pp. D-9 through D-13.
B. Explain how power in an electrical system is related to force times rate.		

CONCEPT: Measurements of Power in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of power in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Power in Mechanical Systems		
Measure power and efficiency in mechanical systems using the appropriate units.	- Student exercises, p. 17 - Lab 6MS1, pp. 19-25	- Lab 6MS1, Measuring Linear Mechanical Power, pp. 27-30 - Lab 6MS2, Power in Rotating Mechanical Systems, pp. 31-50 - Example 6-B, p. 15 - Example 6-C, p. 16
II. Power in Fluid Systems		
A. Demonstrate that power in a fluid system obeys the unifying principle of work divided by time, or "force" times a rate.	- Lab 6MS2, pp. 51-54	- Lab 6MS1, Fluid Power in Fluid Systems, pp. 55-57
B. Measure power in fluid systems.		- Lab 6MS2, Fluid Power Systems, pp. 61-67 - Student exercises, p. 58
III. Power in Electrical Systems		
A. Use the power equation to solve $p = \frac{(\Delta V) \times q}{t}$	- Activity #2, Lab 6MS3, p. 81	- Text, pp. 73-74
B. Measure power in an electrical system.	- Activity #1, Lab 6MS3, pp. 79-80	- Text, p. 75 - Lab 6MS1, Measuring Electric Energy With a Watt-Hour Meter, pp. 83-87

CONCEPT: Measurements of Power in Energy Systems

OBJECTIVE II: The student will measure and solve problems based upon the results of power in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
C. Practical application of electrical power.		- Lab 6E2, Electric Motors and Generators, pp. 89-94
IV. Power in Thermal Systems		
Define and relate power in a thermal system, as work$_H$(energy) divided by time. ($Q_H = \frac{H}{t}$)		- Text, pp. 97-99

CONCEPT: Occupations in Power-Related Technical Fields

OBJECTIVE III: The student will relate the concept of power to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
1. Occupations in Energy-Related Fields		
Research and list occupations that require technicians to measure, control, and otherwise deal with power in energy systems.		- Invite guest speaker and/or conduct field trip. - View and discuss unit video. - Write a research paper. - Consult Principles of Technology Occupational Information. - Prepare oral report.

126

127

SUMMARY OF UNIT 6 POWER

OBJECTIVE:

The student will:

Apply the two formulas, "Power = Work/Time" and "Power = Force x Rate" for mechanical, fluid, and electrical systems.

Define thermal power and thermal rate as "energy divided by time."

Learning Activities

1. Read summary of Unit 6, Power, pp. 101-102.
2. View and discuss video "Summary: Power."
3. Review current occupations related to power.
4. Administer unit test.

UNIT 7 FORCE TRANSFORMERS

OVERVIEW: FORCE TRANSFORMERS

OBJECTIVES:

The student will:

Identify force transformers.

Relate force transformers to mechanical, fluid, and electrical systems.

Learning Activities

1. Read pp. 1-6.

2. View and discuss video tape "Overview: Force Transformers."

3. List and give examples of force transformer systems.

   A. Mechanical
      (1) lever and fulcrum
      (2) inclined surface
      (3) crane
      (4) chain hoist
      (5) auto bumper jack

   B. Electrical
      (1) transformer
      (2) solenoid
      (3) electric motor

   C. Fluid
      (1) hydraulic pistons
      (2) air compressor

UNIT 7 FORCE TRANSFORMERS

CONCEPT: Definition of Force Transformers

OBJECTIVE I: The student will define and describe force transformers as they relate to mechanical, fluid, and electrical systems.

CONCEPT: Measurements of Force Transformers in Energy Systems

OBJECTIVE II: The student will analyze and solve problems based upon the measurements taken from force transformers in energy systems.

CONCEPT: Occupations in Technical Fields Using Force Transformers

OBJECTIVE III: The student will relate the concept of force transformers to occupations in technical fields.

CONCEPT: Definition of Force Transformers

OBJECTIVE I: The student will define and describe force transformers as they relate to mechanical, fluid, and electrical systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Force Transformers in Linear Mechanical Systems		
A. Explain the relationship between work input and work output.		- View and discuss video, "Force Transformers in Linear Mechanical Systems." - Text, pp. 8-9
B. Explain the difference between ideal mechanical advantage (IMA) and actual mechanical advantage (AMA).		- Text, pp. 10-11
C. List or identify different kinds of force transformers for linear mechanical systems.		- Demonstration 7DML, Mechanical Force Transformers, pp. D-3, D-4
II. Force Transformers in Rotational Mechanical Systems		
A. Identify the different kinds of rotational force transformers, and measure the mechanical advantage of each.		- Text, pp. 45-55
B. Describe the relationship between work input and work output for rotational force transformers.		- Text, pp. 44-45
III. Force Transformers in Fluid Systems		
A. List or identify different kinds of fluid transformers.		- Text, pp. 81-89 View and discuss video, "Force Transformers in Fluid Systems."

CONCEPT: Definition of Force Transformers

OBJECTIVE I: The student will define and describe force transformers as they relate to mechanical, fluid, and electrical systems.

SPECIFIC SKILLS	MAIN ACTIVITIES	SUGGESTED ACTIVITIES
B. Explain the relationship between work input and work output for a hydraulic jack.		- Class discussion and demonstration 7DF on Fluid Transformers, pp. D-9, D-10.
IV. Force Transformers in Electrical Systems		
A. Describe how "step-up," and "step-down" transformers are used.		- Text, p. 110 - View video, "Electrical Force Transformers." - Demonstration 7DF, Electrical Force Transformers, pp. D-11 through D-13
B. Discuss the efficiency of an electrical transformer.		- Text, pp. 111-113
C. Explain the relationship between voltage input, voltage output, and number of wire windings in a voltage transformer.		- Lab 7E1/7E2, Electrical Transformers, pp. 123-125
D. Define mechanical advantage of electrical transformers.		- Text, pp. 113-114

CONCEPT: Measurements of Force Transformers in Energy Systems

OBJECTIVE II: The student will analyze and solve problems based upon the measurements taken from force transformers in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
I. Force Transformers in Linear Mechanical Systems		
A. Use the equation, Work Input = Work Output to find an unknown force or displacement when using a pulley or lever as the force transformer.	Lab 7MS1, pp. 23-29	- Example 7-A, p. 11
B. Find the ideal mechanical advantage and actual mechanical advantage of a force transformer.	Lab 7MS1, pp. 23-29	- Example 7-F, p. 19 - Lab 7M1, Linear Mechanical Transformers: The Come-Along Winch, pp. 31-36 - Lab 7M2, Linear Force Transformers: the Screw, pp. 37-41
C. Use the equation for efficiency of a force transformer to find the efficiency of a pulley or lever.		- Lab 7M1, Linear Mechanical Transformers: The Come-Along Winch, pp. 31-36. - Example 7-F, p. 19
II. Force Transformers in Rotational Mechanical Systems		
A. Calculate the mechanical advantage and efficiency of a wheel and axle, gear-drive system, and belt-drive system.	Lab 7MS2, pp. 59-64	- Text, pp. 45-55 - Lab 7M3, Gears, pp. 65-71 - Lab 7M4, Belts and Pulleys, pp. 73-79
III. Force Transformers in Fluid Systems		
A. Calculate the mechanical advantage of a hydraulic jack.		- Lab 7F1, The Hydraulic Jack, pp. 97-[illegible]
B. Calculate the efficiency of a pressure intensifier.		- Lab 7F2, The Pressure Intensifier, pp. 103-107

CONCEPT: Measurements of Force Transformers in Energy Systems

OBJECTIVE II: The student will analyze and solve problems based upon the measurements taken from force transformers in energy systems.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
C. Measure the mechanical advantage of a fluid transformer.	Lab 7MS3, pp. 93-96	- Student exercises, p. 91
IV. Force Transformers in Electrical Systems		
A. Calculate the mechanical advantage and efficiency of a voltage transformer.	Lab 7MS4, pp. 117-119	- Text, p. 113 - Lab 7E2, Electrical Transformers, pp. 125-127

CONCEPT: Occupations in Technical-Fields Using Force Transformers

OBJECTIVE III: The student will relate the concept of force transformers to occupations in technical fields.

SPECIFIC SKILLS	MATH ACTIVITIES	SUGGESTED ACTIVITIES
1. Occupations in Technical Fields Using Force Transformers		
Research and list occupations that require technicians to measure, control, or otherwise deal with force transformers in complex devices.		- Invite guest speakers and/or conduct field trip. - View and discuss unit videos. - Write research paper. - Consult Principles of Technology Occupational Information Appendix B. - Prepare oral report.

141

142

SUMMARY OF UNIT 7 FORCE TRANSFORMERS

OBJECTIVES: The student will:

Recognize that force transformers usually amplify an input such as force, torque, displacement, or speed resulting in a mechanical advantage.

Learning Activities

1. Read summary of Unit 7, Force Transformers, pp. 131-133.
2. View and discuss "Summary: Force Transformers."
3. Review current occupations related to force transformers.
4. Administer unit test.

143

144

APPENDIX A

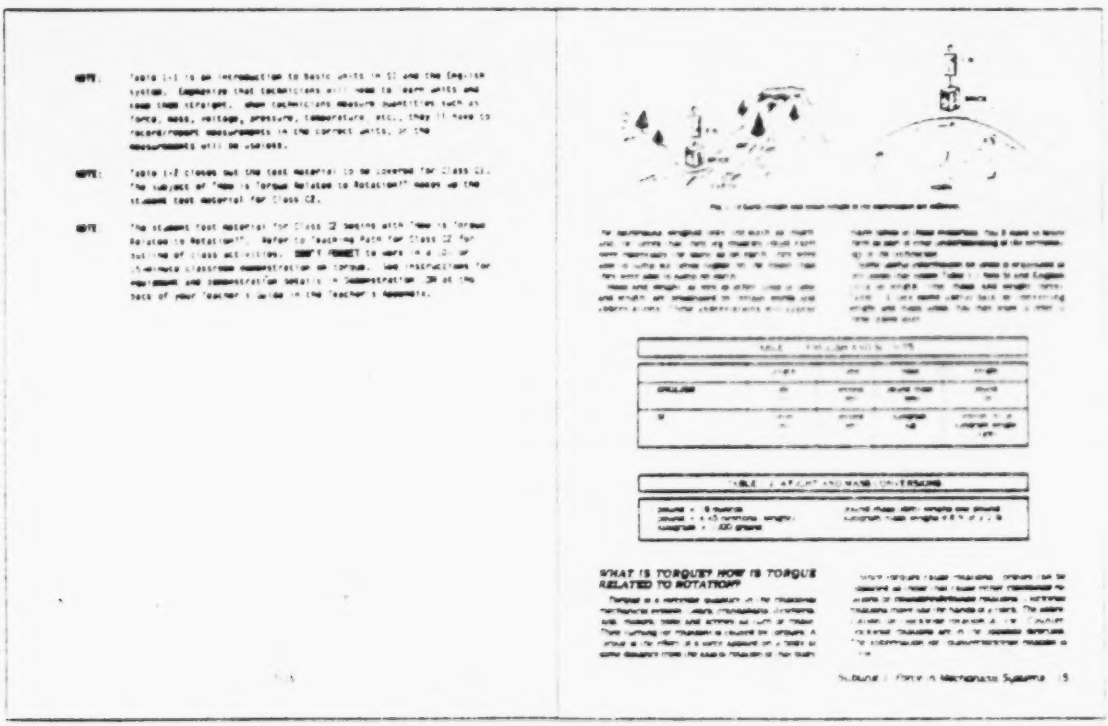
To the Teacher

To the Teacher

How's This Teacher's Guide Organized?

Welcome to the teaching of *Principles of Technology* (PT). The Teacher's Guide to this course consists essentially of these introductory pages, the student text, a large number of separate teacher-guide pages and an Appendix. Why is this arrangement used? Because the *Principles of Technology* course involves the use of video, laboratories, student readings and exercises, teacher demonstrations and discussions. This Teacher's Guide provides you with a means to orchestrate these elements.

For example, you'll find the student text on right-hand, consecutively numbered pages. All pages in the Guide designated with a "T" before the page number present teaching suggestions, content notes and answers to questions. (See Figure 1 below.) There are Teaching Paths preceding each activity within the unit. The "T" designator indicates pages that have been written to the teacher. Pages with the "T" designator are not part of the student text.



a. Teacher's aids. b. Student text.

Fig. 1 Teacher's Guide/Student Text Example.

As in Figure 1, the Guide provides you with acceptable answers to questions asked of the student in the text. The teacher's page also often relates figures or portions of the text to the video. Other pages of the Guide contain explanations, recommendations for procedures in presenting video segments, lab precautions designated with the ▲ CAUTION symbol, demonstrations that you can perform, and so forth.

Teacher demonstrations are located in the back of the Teacher's Guide in the second Appendix. (All page numbers in this Appendix are designated with a "D" before the page number.) Demonstrations are written in a step-by-step fashion, with ample explanation provided about how to set up equipment, the correct procedures to use in completing the demonstration, etc. You may wish to ask students to help you do these demonstrations—or select students to do the demonstrations—to give students extra involvement throughout the course.

Care has been taken in PT development to account for the individual differences among students. Therefore, the Appendix located in the student text contains Preparatory Math Skills Labs. For example, in Unit 1, "Force," there are four preliminary math exercises. These activities should be used if students need to develop their math skills in order to bring themselves "up to speed" for Unit 1 math ability requirements.

Other auxiliary teaching aids include Student Challenges, located at the end of each subunit. These activities are provided to motivate your brightest students. In addition to this auxiliary portion of the text, there is also a Unit Breakdown, which provides a handy reference to the proposed activities within each unit, and the Glossary, which defines terms that are used in the text with which your students may not be familiar. You may find that referring your students to the Glossary at the beginning of each unit of study will help them tackle the text with more confidence.

Note that this is a general plan.

In using the guide, remember that it's only a road map; i.e., the Teacher's Guide is not a set of rigid rules that must be followed. The Guide certainly isn't intended to inhibit your ingenuity or curiosity—both of which you will undoubtedly wish to use—in order to make the course more interesting to your students and to yourself. This Guide assumes that you haven't read similar material in connection with PT. However, auxiliary material, such as the PT Implementation Notebook and PT brochures, may contain additional information that can be useful to you.

The *Principles of Technology* staff recognizes that you, the teacher, are the "front-line"—that your input is crucial to the success of the course. Consequently, a major effort has been made to develop *Principles of Technology* to meet your teaching needs, as well as your students' learning needs.

Why Is There A Need For Principles of Technology?

Principles of Technology is an up-to-date, technologically sophisticated system of instruction. PT increases the flexibility of students entering the job market and thereby increases their chances of finding employment—and of retraining themselves as their careers develop. In addition, the two-year course is structured to meet the criteria for accreditation in both general academic high schools and vocational schools. PT provides instruction in the fundamental principles of technology. The need for a course like PT has been expressed by many persons in vocational education, including the National Commission on Secondary Vocational Education.

The central idea of this curriculum is that a technically valid, unifying approach is beneficial in the study of the basic energy systems—mechanical, fluid, electrical and thermal. This approach is achieved by showing that principles such as force, work, rate and resistance operate in a parallel way among most systems, as indicated in Figure 2.

ENERGY SYSTEMS

PRINCIPLES	MECHANICAL	FLUID	ELECTRICAL	THERMAL
(1) FORCE	X	X	X	X
(2) WORK	X	X	X	NOT APPLICABLE
(3) RATE	X	X	X	X
(4) RESISTANCE	X	X	X	X
(5) ENERGY	MECHANICAL AND FLUID 1		X	X
	MECHANICAL AND FLUID 2			
(6) POWER	X	X	X	X
(7) FORCE TRANSFORMERS	MECHANICAL 1	X	X	NOT APPLICABLE
	MECHANICAL 2			

Fig. 2 Extent of unification principles in four energy systems, Units 1-7

ENERGY SYSTEMS

PRINCIPLES	MECHANICAL	FLUID	ELECTRICAL	THERMAL
(8) MOMENTUM	MECHANICAL AND FLUID 1		NOT APPLICABLE	NOT APPLICABLE
	MECHANICAL AND FLUID 2			
(9) WAVES AND VIBRATIONS	WAVE CHARACTERISTICS			
	WAVE APPLICATIONS			
(10) ENERGY CONVERTORS	X	X	X	X
(11) TRANSDUCERS	X	X	X	X
(12) RADIATION	ELECTROMAGNETIC			
	NUCLEAR			
(13) OPTICS AND OPTICAL SYSTEMS	WAVE OPTICS			
	RAY OPTICS			
	LASER LIGHT			
	OPTICAL SYSTEMS			
(14) TIME CONSTANTS	X		X	

Fig. 3 Extent of unification principles in four energy systems, Units 8-14.

How Was *Principles of Technology* Developed?

Principles of Technology is the result of three years of development. It represents the cooperative effort of a consortium of over 43 state and provincial vocational education agencies, the Center for Occupational Research and Development (CORD), and the Agency for Instructional Technology (AIT).

During development, CORD and AIT prepared drafts of print materials, scripts of video materials, and pilot videos. These materials were reviewed by an independent eight-member team of specialists in vocational education and instructional media, as well as by the state and provincial consortium agency representatives. Of course, teachers were instrumental in the process of creating *Principles of Technology*. In fact, teachers were crucial members of the PT team during the pilot research. They provided data and made recommendations that resulted in modification of the instructional media. Thus, *Principles of Technology* was—to a large extent—tailored by experienced teachers.

Principles of Technology is based on the Unified Technical Concepts (UTC) curriculum developed by CORD. UTC is postsecondary instruction in applied physics that is taught at community colleges, technical schools and a part of industry training programs.

Who Developed *Principles of Technology*?

Principles of Technology was developed by a consortium of 43 U.S. states and Canadian provinces. Project staff consisted of a team from two nonprofit organizations: the Agency for Instructional Technology of Bloomington, Indiana, and the Center for Occupational Research and Development, of Waco, Texas.

The Agency for Instructional Technology (AIT) is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television, related print, and computer materials for use as major learning resources. It makes many of these materials available in audiovisual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor organization, National Instructional Television, was founded in 1962.

The Center for Occupational Research and Development (CORD) conducts research and development activities and disseminated curricula for technical and occupational training. During its 10-year history, CORD has developed over 46,000 pages of instructional materials for technicians on 16 major projects in advanced-technology areas. CORD projects are sponsored by contracts with federal and state agencies and groups of interested educators and industries. CORD products are used by industrial vocational high school programs throughout the world.

In developing the 14 student texts and 14 teacher's guides of *Principles of Technology*, CORD ensured that the content was both current and broad so that students would be prepared to meet the changing demands of the technical workplace. CORD recognized that only a course of study emphasizing basic physical principles and related fundamental mathematics could achieve this goal.

The 80 *Principles of Technology* video programs created by AIT enliven the print material by demonstrating its real-world application and showing on-the-job technicians who explain how technical principles apply to what they do. In collaboration and with careful thought, CORD and AIT have combined varied methods and media to develop logical, pedagogically sound materials that bring students into the world of work.

Principles of Technology labs give students hands-on experience as they develop physics and mathematics skills and learn the way these skills relate to specific occupations. Both remedial and advanced learning paths are available to *Principles of Technology* students. Work with classroom pilot-teachers and students contributed greatly to the refining of the course and augmented the regular activities of review team members. Finally, important advice of curriculum design came from the consortium's state and provincial vocational education leaders.

How Do You Begin To Teach *Principles of Technology?*

Principles of Technology (PT) is a high school course in applied physics for those who plan to pursue careers as technicians—or just keep pace with the advances in modern technology. PT blends an understanding of basics and principles with practice. Furthermore, PT builds a firm foundation for understanding technology—with today's technology ***and*** tomorrow's technology.

In content, PT is a two-year course that has 14 units. Each unit is devoted to the study of an important concept that undergirds technology—a concept like **force, work, rate, resistance, energy** or **power.** Each unit explains what the principle is and how it's used in **mechanical, fluid, electrical** and **thermal** systems. Each unit builds on the knowledge learned in the previous unit. Thus, the 14 units, when taken together, help one understand modern, interdisciplinary systems—like robots—where mechanical, fluid, electrical and thermal devices often work together, and where many important principles are applied.

What Are The General Course Characteristics?

I. Goals
   - A. Students will learn principles of technology and will use the associated mathematics.
   - B. Students will recognize that technicians must understand basic technical principles, that these principles undergird the world of technology, and that these principles apply to the mechanical, fluid, electrical and thermal energy systems found in technological devices.
   - C. Students will develop confidence in their ability to understand and apply scientific concepts and principles.

II. Educational and Vocational Utility of PT
   - A. PT supports and strengthens current vocational technical programs over a two-year sequence, usually beginning at the eleventh-grade level and continuing through the twelfth grade. (PT may be adapted by schools for use prior to the eleventh-grade level or subsequent to the twelfth grade.)
   - B. PT better prepares students for future technical education in employer-based training programs and postsecondary schools.
   - C. PT satisfies one or two years of the science requirement for high school graduation in most states and provinces.

III. Target Audience
   - A. Students
     1. Are primarily eleventh-grade level students interested in technical careers. (The second year of the program is for students who have completed the first year of *Principles of Technology*.)
     2. Should have completed one year of high school mathematics.
   - B. Instructors
     1. Are faculty who have an interest in vocational/technical students.
     2. Are either familiar with—or willing to become familiar with—the physics and associated mathematics in the course, or who will team teach with others who are qualified in each area of specialty.

IV. Content

A. Instructional Design

1. Science content consists of

a. Fourteen broad-based physics concepts relevant to the technological workplace. Each concept is organized in a unit of instruction.

b. The technical concepts of **Force, Work, Rate, Resistance, Energy, Power** and **Force Transformers** are the first-year units.

c. The technical concepts of **Momentum, Waves and Vibrations, Energy Convertors, Transducers, Radiation, Light and Optical Systems** and **Time Constants** are second-year instructional units.

2. The sequence of instruction is

a. First seven units must be taught in order.

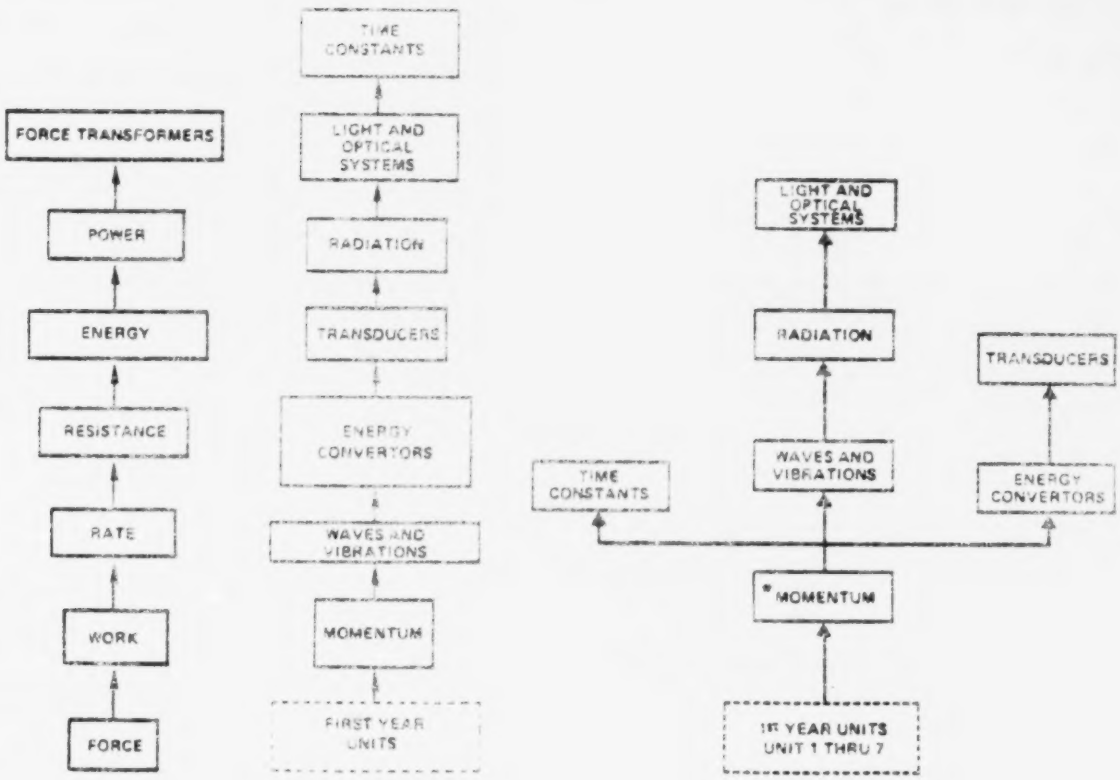
b. Second seven units may also be taught in numbered order or in the optional paths shown in the figure below.

*Note that **Momentum** must be taught first before choosing any of the other sequences.

3. Mathematics Content

a. Is determined by the physics content.

b. Both SI and English units of measure are used.



a. First year. b. Second year, numbered order. c. Second year, optional paths.

Fig. 4 Instruction Units in *Principles of Technology*.

B. Treatment of Content (in all project materials)

1. Whenever possible, technical concepts are related to technicians and devices in the context of the workplace.
2. A wide range of technicians and devices are shown.
3. The video and print correlate in terms of textual and graphic illustrations.
4. Terminology is consistent in project components.
5. Language and reading level are appropriate for high school vocational/technical students.

What's the Suggested General Teaching Plan?

Each of the 14 technical concepts is covered in a **unit** of study. The suggested teaching plan generally requires 26 classes of 50 minutes each for each unit. (See Table 1.)

TABLE 1. General Teaching Plan

	UNIT OVERVIEW CLASS 1	O					
MECHANICAL SYSTEMS	SUBUNIT 1 CLASS 2 - 7	C1	C2	M	L1	L2	R
FLUID SYSTEMS	SUBUNIT 2 CLASS 8 - 13	C1	C2	M	L1	L2	R
ELECTRICAL SYSTEMS	SUBUNIT 4 CLASS 14 - 19	C1	C2	M	L1	L2	R
THERMAL SYSTEMS	SUBUNIT 3 CLASS 20 - 25	C1	C2	M	L1	L2	R
	UNIT SUMMARY CLASS 26	S					

Legend:
O: Unit Overview/Video
C1, C2: Video, classroom discussion, demonstration
M: Math laboratory
L1, L2: Laboratory practice
R: Review of current subunit
S: Unit summary/Video

Note that this is a general plan. Different units will have different plans. Thus, Unit 1, "Force," is preceded by an extra class that provides an introduction and overview of the **entire** course. After this initial class, the general plan is the same. In subsequent units, the first class is devoted to an introduction and overview of the unit—rather than the course. This "Unit Overview" class is, of course, shown in Table 1. (See the Breakdown of "Force" at the beginning of Unit 1.) The teaching pattern depends on how many subunits are included in the unit. (See Figure 2 on previous page.)

The last class of each unit—generally the 26th class—is designed for a unit review/summary and test. The 24 or so intervening classes are divided into four **subunits** of six classes each.

	INTERPRETATION
→	The first class for each unit is devoted to an overview. A video program is shown, a class discussion conducted, and reading assignment given.
C1 →	During the second class (C1), students view a video program, discuss both the video program and their previous reading assignment, and are given a new reading assignment.
C2 →	During the third class (C2), students observe a teacher demonstration, discuss this and their previous reading assignment, and complete the Student Exercises in the textbook. The teacher reviews student mastery of Student Exercises with the students. Reading assignments for the topics to be covered in the next class, the Math Skills Lab (M), should be made by the teacher.
M →	The fourth class—the Math Skills Lab (M)—consists of practice activities to strengthen those mathematical skills students need to deal with the technical content presented in "C1" and "C2" classes. During this class, the teacher guides students through a series of examples and problems in the math practice exercises. At the end of this class, the teacher assigns students to groups in preparation for the application labs (L1 and L2), and assigns material to be read in preparation for each lab.
→	The fifth class is the concept application lab (L1). The teacher overviews lab one for the entire class. Then the entire class, working in small groups, may complete lab one. Students are given a reading assignment to prepare them for L2's activities.
→	During the sixth class, concept application laboratory two (L2), students complete the lab not worked on during concept application lab one.
→	The seventh class consists of a review (R), and an optional test. The teacher gives the reading assignment from the next subunit.
→	The eighth through twenty-fifth classes repeat the pattern of C1, C2, M, L1, L2, and R, but focus on different energy systems.
→	The twenty-sixth class (S) provides for a unit summary review and optional test that covers the unit.

B. Time Allocations

1. Classroom instruction, mathematics laboratories and application labs are designed for 50-minute class periods.
2. Classes may be combined, depending on your school's administrative requirements.
3. Each student study assignment will require about 30 minutes.
4. The teacher's preparation for each period during the initial year should range from 20 to 30 minutes.

III. Equipment Requirements

In the process of identifying and selecting equipment for the application laboratories, consideration has been given to cost factors, the utility of equipment for multi-use and the equipment's adaptability for learning/illustrating the technical concepts presented in *Principles of Technology*.

IV. Speaking of Problems

Note again, that this Guide is only a Guide and cannot substitute for your own experience and ingenuity in solving problems that may arise in teaching this—or any other—course. Here are samples of some of the problems that have come up during the PT pilot test—and some of the solutions discovered by PT teachers.

- "What if the proper laboratory equipment is not available?"

In this case, you might improvise the "next best" equipment; do another experiment for which equipment is available; or, as a last resort, describe the experiment, its purpose, and its expected outcome.

- "What if the class falls behind schedule?"

In this case, you might combine two classes—C1 and C2 for example—but you should avoid changing the suggested sequence of instruction. (But don't forget, the schedule is just a guide.)

- "What if there are too few lab stations, say three for 15 students?"

In this case, you might have students take turns, doing labs on different days; you might have students work together in pairs or teams; or you might divide the class in half, part of them doing one lab while the rest are doing another and then changing places.

- "What if there's a wide diversity of student ability?"

Many pilot test teachers have discovered that this situation provides a perfect opportunity to utilize peer teaching.

- "What if I feel weak in teaching physics or mathematics?"

In this case, you might want to arrange to team teach the course with a physics or mathematics teacher or arrange for a physics or mathematics teacher to come in only when needed as a resource person.

Other sources of help include your principal, other administrative personnel, other teachers who have already taught *Principles of Technology*, colleagues who are implementing *Principles of Technology* in other schools, your state or provincial consortium representative—as well as CORD and/or AIT.

If you need help with Principles of Technology, contact your state or provincial consortium representative or call CORD at 1/800/231-3015. CORD developed the print portions of the course. Call AIT at 1/800/457-4509. AIT developed the video.

It's to your advantage to explore the nature and availability of these potential sources of help even before you need help on a serious problem. You will then know to whom you can turn and what help you can expect when the need arises.

And now, best wishes for a good experience teaching *Principles of Technology*. We hope that you find satisfaction in knowing that you are one of those who work to advance vocational education, who prepare students for the new "technological society," and who find personal enjoyment in teaching this course.

Teaching Path for the 'Overview' Principles of Technology Course

RESOURCE MATERIALS

Video: "About Principles of Technology"
Student Text: No previous assignment has been given.

This video is an "Overview" of the two-year course, Principles of Technology. It's an orientation video, and it can be used with community groups as well as with students.

CLASS GOALS

In this introductory session, you should help your students understand the following:

1. The meaning of "system" and "subsystem."
2. The meaning of "principles," when used to explain the operation of systems and subsystems.
3. The advantages of learning principles rather than mere descriptions or procedures of operation of systems.
4. The structure of the course—

Video presentations	Demonstrations
Student text	Hands-on laboratories
Classroom discussions	Review sessions

CLASS ACTIVITIES

Since the students coming to this first class will not have had an opportunity to prepare for class by reading the text, you'll need to do most of the work. Show the video. Discuss the video. Then, if time remains, preview the student text.

1. If you haven't already done so, read the introductory pages in this Teacher's Guide in detail. Note the general and overview features in particular, since these relate to the main thrust of the video.
2. Read the next page—"Before the Video," "Summary," and "Discussion Questions."
3. Preview the video before showing it to your class. Check the "Overview" video against the suggested pre- and post-discussion questions. List questions of your own, in addition to—or in place of—those suggested questions.
4. Before viewing the video, you may wish to ask the questions in the "Before the Video" section (next page) or use your own questions to prepare the students for the viewing. Similarly, you may wish simply to read the "Summary" section, or to supplement it with information gained from your own previewing. In any case, both discussion and summary before the program are advisable.
5. During the discussion after the program, focus on the most significant points. You'll probably wish to leave some time for a review of the student text, as suggested below.
6. In the remaining time, distribute the student texts of Unit 1, "Force." Review the text's main features. Point out such aids as the Table of Contents for each unit, the Learning Paths for each subunit, the Student Exercises, the Preparatory Math Labs and the Glossary. Explain why many subheads are written as questions (to help as study aids).
7. Ask students to read Unit 1's "Overview" before your next session.

'About Principles of Technology'
A Video Overview of PT

BEFORE THE VIDEO

Tell students/viewers that they're going to see a video program that describes the Principles of Technology course.

SUMMARY OF THE VIDEO

This video program introduces students, and others who may view it, to Principles of Technology. It explains how, in the world of modern technology, one can be successful if he or she understands the technical principles and concepts being applied in the workplace. The viewer learns that it's important to understand the science behind the technology.

A preview of upcoming video segments and student-teacher classroom events shows students what to expect as they work their way through the course.

Viewers will learn how the "principles of technology" are tools for the brains of modern technicians—and how they'll be using these tools in classroom discussions and laboratory hands-on experiments (math and science).

Students will learn that a system in any combination of parts will work together to do a specific job. The video shows examples of mechanical, fluid, electrical and thermal systems. These systems act in similar ways. Basic principles such as force, rate and resistance all operate "across the four systems."

The program tells viewers what's covered in the 14 units of the course. The video concludes by stressing that anyone who understands what makes things work will be better prepared to meet the changes tomorrow's technology will bring, since "technological literacy" means incorporating change and new information throughout one's lifetime.

DISCUSSION QUESTIONS ABOUT THE VIDEO

1. How have technician jobs changed in the last several years? (Advanced technology has resulted in improving the performance of equipment. Because of these improvements, technicians must be familiar with several technical areas rather than learning a traditional skill area.)
2. How would an understanding of the Principles of Technology benefit a recent PT graduate when he/she applies for a job in a technological field? (The training required for a specific job will be minimized, since basic principles are already known and only particular job skills need to be learned.)
3. When technology changes and gets more complicated, which technicians will be best able to cope with the changes? (Those technicians who have a reservoir of basic technology principles to draw upon will be best able to cope with change. This ability will allow the technician to have the ability to change and adapt to new information.)

Notes on Teacher's Guide
Principles of Technology

BREAKDOWN OF UNIT 1:

This sheet gives you an overview of the activities within Unit 1.

TEACHING PATHS:

Teaching Paths are numbered as "T" pages. Teaching Paths usually are on the right-hand side of your Guide and have lines running vertically (the length of the page) to help you locate them. The Teaching Path for the subunit review is on the left. You'll find a synopsis of each video segment behind the Teaching Path for the Overview, one for each subunit, and one for the Summary of Unit 1. Teaching Paths precede each section within each subunit: Overview (O); C1, C2; Math Skills Lab (M); and Application Lab 1 (L1), Application Lab 2 (L2); the Review (R) and the Summary (S).

TEACHING TIPS:

Hints about the materials in the student text are usually located on the left-hand side of your Guide. These pages are designated with a "T." The answers to questions within the student materials are also on these "T" pages.

GLOSSARY:

The Glossary is also part of the student materials. You may wish to remind your students that they must understand the vocabulary in order to understand the units of this course. Because this understanding is so important, you may wish to discuss the words in the Glossary with your students before--or during--their study of Unit 1.

PREPARATORY MATH SKILLS LAB:

These activities will assist your teaching of necessary math skills for Unit 1. If you wish, you may omit these activities. The Preparatory Math Skills Labs are part of the student text and are located in an Appendix for easy student reference.

END-OF-UNIT STUDENT EXERCISES:

These questions are part of the student text. They will test your students' knowledge of the material in this unit.

DEMONSTRATIONS:

Demonstrations are located at the back of your Guide in the Appendix. Therefore, these pages are prefixed with a "D." There's a demonstration activity for each subunit of Unit 1. We suggest that you conduct the demonstration as a part of Class C2; however, some instructors elect to let students do the demonstration as a peer teaching experience. Please note ▲ CAUTIONS within the demonstrations and throughout the student text.

Breakdown of Unit 1: Force

Designator	Class	Subunit Title	Class Activity	Video Time	Student Text Page No.
O	1	Overview of Unit 1: "Force"	Overview Video on "Force" Class Discussion	8:22 min.	1 - 6
C1	2	FORCE IN MECHANICAL SYSTEMS	Mechanical Force Subunit Video Class Discussion	5:35 min.	7 - 19
C2	3		Class Discussion and Demonstration LDM on Torque		
M	4		Student Exercises		20 - 21
			Math Skills Lab		23 - 29
L1	5		Lab 1M1 - Measuring Forces		31 - 36
L2	6		Lab 1M2 - Mechanical Stress		37 - 42
R	7		Review of Mechanical Force		42
C1	8	PRESSURE IN FLUID SYSTEMS	Fluid Force Subunit Video Class Discussion	6:16 min.	43 - 54
C2	9		Class Discussion and Demonstration LDM on Pressure		
M	10		Student Exercises		53 - 54
			Math Skills Lab		55 - 57
L1	11		Lab 1F1 - Measuring Specific Gravity		59 - 61
L2	12		Lab 1F2 - Measuring Pressure		63 - 68
R	13		Review of Fluid Force		68
C1	14	VOLTAGE IN ELECTRICAL SYSTEMS	Electrical Force Subunit Video Class Discussion	5:23 min.	71 - 76
C2	15		Class Discussion and Demonstration LDE on Voltage		
M	16		Student Exercises		77
			Math Skills Lab		79 - 82
L1	17		Lab 1E1 - Measuring Voltage		83 - 86
L2	18		Lab 1E2 - Electrical Circuits		87 - 90
R	19		Review of Electrical Force		90
C1	20	TEMPERATURE IN THERMAL SYSTEMS	Thermal Force Subunit Video Class Discussion	4:10 min.	91 - 96
C2	21		Class Discussion and Demonstration LDT on Temperature Differences		
M	22		Student Exercises		97 - 98
			Math Skills Lab		99 - 101
L1	23		Lab 1T1 - Measuring Temperature with Thermometers		103 - 106
L2	24		Lab 1T2 - Measuring Temperature with Thermocouples		107 - 112
R	25		Review of Thermal Force		112
S	26	Summary of Unit 1: "Force"	Summary Video on "Force"	5:23 min.	113 - 114

The first Appendix includes four Preparatory Math Skills Labs. These Math Skills Labs are followed by the End-of-Unit Student Exercises. Instructions for conducting the Demonstration activities are in the second Appendix. This Appendix isn't included in the student's books.

Breakdown of Unit 2: 'Work'

Designator	Class	Subunit Title	Class Activity	Video Time	Page
O	1	"Overview" of Unit 2: "Work"	Overview Video on "Work" Class Discussion	5:50 min.	
C1	2	WORK IN MECHANICAL SYSTEMS	Mechanical Work Subunit Video Classroom Discussion	8:19 min.	
C2	3		Class Discussion and Demonstration 2DM on Mechanical Work		
M	4		Student Exercises		15 - 16
L1	5		Math Skills Lab $2^{M}_{S}1$		17 - 20
L2	6		Lab 2M1 - Work Done by Pulleys		21 - 25
R	7		Lab 2M2 - Work Done by a Winch		27 - 32
C1	8	WORK IN FLUID SYSTEMS	Review of Mechanical Work		33
C2	9		Fluid Work Subunit Video Class Discussion	7:13 min.	
M	10		Class Discussion and Demonstration 2DF on Fluid Work		35 - 36
L1	11		Student Exercises		43 - 44
L2	12		Math Skills Lab $2^{M}_{S}2$		45 - 46
R	13		Lab 2F1 - Work Done by a Piston		49 - 52
C1	14	WORK IN ELECTRICAL SYSTEMS	Lab 2F2 - Work Done by a Water Pump		57 - 60
C2	15		Review of Fluid Work		61
M	16		Electrical Work Subunit Video Class Discussion	8:20 min.	
L1	17		Class Discussion and Demonstration 2DE on Electrical Work		63 - 64
L2	18		Student Exercises		71 - 72
R	19		Math Skills Lab $2^{M}_{S}3$		73 - 76
			Lab 2E1 - Work Done by a Motor		77 - 80
			Lab 2E2 - Work Done by a Solenoid		85 - 88
			Review of Electrical Work		89 - 90
S	20	"Summary" of Unit 2, "Work"	Summary Video on "Work"	6:59 min.	91 - 92
SUPPLEMENTAL		GLOSSARY	(Please review.)		93
SUPPLEMENTAL		PREPARATORY MATH LABS	(Optional: use at will.)		95 - 110
UNIT 2 TEST		END-OF-UNIT EXERCISES	(Review of Objectives.)		111 - 112
SUPPLEMENTAL		DEMONSTRATIONS	(Instructions on setup.)		D-1 - D-13

Breakdown of Unit 3: 'Rate'

Designator	Class	Subunit Title	Class Activity	Video Time	Student Text Page No.
O	1	"Overview" of Unit 3, "Rate"	Overview Video on Rate Classroom Discussion	10.24 min.	1 - 5
C1	2	RATE IN MECHANICAL SYSTEMS	Mechanical Rate Subunit Video Classroom Discussion	7.20 min.	7 - 15
C2	3		Class Discussion and Demonstration 3DM on Mechanical Rate		
M	4		Student Exercises		17 - 18
L1	5		Math Skills Lab $3^{M}_{S}1$		19 - 24
L2	6		Lab 3M1 - Measuring Linear Rate on Conveyor Belts		25 - 28
R	7		Lab 3M2 - Measuring Angular Rate with a Stroboscope		29 - 33
C1	8	RATE IN FLUID SYSTEMS	Review of Mechanical Rate		33
C2	9		Fluid Rate Subunit Video Classroom Discussion	5.14 min.	35 - 39
M	10		Class Discussion and Demonstration 3DF on Fluid Rate Measurement		
L1	11		Student Exercises		40
L2	12		Math Skills Lab $3^{M}_{S}2$		41 - 45
R	13		Lab 3F1 - Measuring Liquid Flow Rate in a Channel		47 - 51
C1	14	RATE IN ELECTRICAL SYSTEMS	Lab 3F2 - Measuring Gas Flow Rates with an Orifice		53 - 58
C2	15		Review of Fluid Rate		58
M	16		Electrical Rate Subunit Video Classroom Discussion	7.10 min.	59 - 68
L1	17		Class Discussion and Demonstration 3DE on Electrical Rate		
L2	18		Student Exercises		67 - 68
R	19		Math Skills Lab $3^{M}_{S}3$		69 - 79
C1	20	RATE IN THERMAL SYSTEMS	Lab 3E1 - Measuring Current		81 - 84
C2	21		Lab 3E2 - Measuring Frequency		85 - 90
M	22		Review of Electrical Rate		90
L1	23		Thermal Rate Subunit Video Classroom Discussion	7.00 min.	91 - 99
L2	24		Class Discussion and Demonstration 3DT on Thermal Rate Measurement		
R	25		Student Exercises		100 - 101
S	26	"Summary" of Unit 3, "Rate"	Math Skills Lab $3^{M}_{S}4$		103 - 108
			Lab 3T1 - Measuring Heat Flow Rate		109 - 116
			Lab 3T2 - Measuring Cooling Rate		117 - 121
			Review of Thermal Rate		121
			Summary Video on "Rate"	10.52 min.	123 - 124
SUPPLEMENTAL		GLOSSARY	(Please review.)		125
SUPPLEMENTAL		PREPARATORY MATH LABS	(Optional: use at will.)		127 - 141
UNIT 3 TEST		END-OF-UNIT EXERCISES	(Review of Objectives.)		143 - 146
SUPPLEMENTAL		DEMONSTRATIONS	(Instructions on setup.)		D-1 - D-19

Breakdown of Unit 4: Resistance

Designator	Class	Subunit Title	Activity		
O	1	"Overview" of Unit 4, "Resistance"	Overview of Unit 4 Objectives and Discussion		
C1	2	RESISTANCE IN MECHANICAL SYSTEMS	Mechanical Resistance Subunit Video and Classroom Discussion		
C2	3		Class Discussion and Demonstration ADE on Mechanical Resistance to Air Flow		
M	4		Student Exercises		
L1	5		Math Skills Lab $4^{M}_{S}1$		
L2	6		Lab 4M1 - Measuring Friction in Lubricants		
R	7		Lab 4M2 - Streamlining Shapes to Reduce Air Drag		
C1	8		Review of Mechanical Resistance		
C2	9	RESISTANCE IN FLUID SYSTEMS	Fluid Resistance Subunit Video and Class Discussion	9:40 min	
M	10		Class Discussion and Demonstration ADE on Resistance to Air Flow		
L1	11		Student Exercises		
L2	12		Math Skills Lab $4^{M}_{S}2$		
R	13		Lab 4F1 - Measuring Fluid Resistance in Pipes		
C1	14		Lab 4F2 - Measuring Resistance in Air Filters		
C2	15	RESISTANCE IN ELECTRICAL SYSTEMS	Review of Fluid Resistance		
M	16		Electrical Resistance Subunit Video and Class Discussion	7:10 min	
L1	17		Class Discussion and Demonstration ADE on Electrical Resistance and Ohm's Law		
L2	18		Student Exercises		
R	19		Math Skills Lab $4^{M}_{S}3$		
C1	20		Lab 4E1 - Ohm's Law and Series Circuits		
C2	21	RESISTANCE IN THERMAL SYSTEMS	Lab 4E2 - Ohm's Law and Parallel Circuits		
M	22		Review of Electrical Resistance		
L1	23		Thermal Resistance Subunit Video and Class Discussion		
L2	24		Class Discussion and Demonstration ADE on Thermal Resistance		
R	25		Student Exercises		
S	26	"Summary" of Unit 4, "Resistance"	Math Skills Lab $4^{M}_{S}4$		
GR	27	"General Review" of "Force", "Work", "Rate", "Resistance"	Lab 4T1 - Measuring Resistance of Thermal Insulation		
SUPPLEMENTAL		GLOSSARY	Lab 4T2 - Effect of Thermal Insulation		
SUPPLEMENTAL		PREPARATORY MATH LABS	Review of Thermal Resistance		
UNIT 4 TEST		END-OF-UNIT EXERCISES	Summary video on "Resistance"	5:14 min	
SUPPLEMENTAL		DEMONSTRATIONS	Overview of Each Unit (Force, Work, Rate and Resistance)		
			(Please review.)		
			(Optional: use at will.)		
			(Review of Objectives.)		
			(Instructions on setup.)		

Breakdown of Unit 5: 'Energy'

Designator	Class	Subunit Title	Class Activity	Video Time	Student Text Page No.
O	1	"Overview" of Unit 5: "Energy"	Overview Video on "Energy" Class Discussion	8:36 min.	1 - 7
C1	2	ENERGY IN MECHANICAL AND FLUID SYSTEMS I	Energy Systems I Subunit Video Classroom Discussion	11:51 min.	9 - 12
C2	3		Class Discussion and Demonstration SDM on Potential and Kinetic Energy		
M	4		Student Exercises		13
L1	5		Math Skills Lab $S^{M}_{5}1$		21 - 26
L2	6		Lab SMF1 - Measuring the Potential Energy of a Spring Lab SMF2 - Energy Stored in a Hydraulic Accumulator		27 - 33 35 - 40
R	7		Review of Energy Systems I		41
C1	8	ENERGY IN MECHANICAL AND FLUID SYSTEMS II	Energy Systems II Subunit Video Class Discussion	8:29 min.	43 - 53
C2	9		Class Discussion and Demonstration SDF on Potential and Kinetic Energy		
M	10		Student Exercises		55
L1	11		Math Skills Lab $S^{M}_{5}2$		57 - 62
L2	12		Lab SMF3 - Using Energy in Compressed Air to Operate Air Motors Lab SMF4 - Measuring the Kinetic Energy of a Rotating Flywheel		63 - 65 67 - 72
R	13		Review of Energy Systems II		73
C1	14	ENERGY IN ELECTRICAL SYSTEMS	Electrical Energy Subunit Video Class Discussion	8:10 min.	75 - 81
C2	15		Class Discussion and Demonstration SDE on Capacitor Voltage Change		
M	16		Student Exercises		83
L1	17		Math Skills Lab $S^{M}_{5}3$		85 - 89
L2	18		Lab SE1 - Energy Stored in a Capacitor Lab SE2 - Converting Fluid Energy to Electrical Energy		91 - 98 99 - 102
R	19		Review of Electrical Energy		103
C1	20	ENERGY IN THERMAL SYSTEMS	Thermal Energy Subunit Video Class Discussion	8:42 min.	105 - 111
C2	21		Class Discussion and Demonstration SDT on Thermal Energy		
M	22		Student Exercises		113
L1	23		Math Skills Lab $S^{M}_{5}4$ Lab ST1 - Equilibrium Temperature of a Mixture		115 - 122 123 - 126
L2	24		Lab ST2 - Thermal Energy and Specific Heat of a Metal		127 - 130
R	25		Review of Thermal Energy		131
S	26	"Summary" of Unit 5: "Energy"	Summary Video on "Energy"	8:42 min.	133 - 135
SUPPLEMENTAL		GLOSSARY	(Please review.)		137
SUPPLEMENTAL		PREPARATORY MATH LABS	(Optional: use at will.)		139 - 148
UNIT 5 TEST		END-OF-UNIT EXERCISES	(Review of Objectives.)		149 - 150
SUPPLEMENTAL		DEMONSTRATIONS	(Instructions on setup.)		D-1 - D-17

Breakdown of Unit 6: 'Power'

Designator	Class	Subunit Title	Class Activity	Video Time	Student Text Page No.
O	1	Overview of Unit 6, "Power"	Overview Video on "Power" Class Discussion	7:42 min.	3
C1	2	MECHANICAL SYSTEMS	Mechanical Power Subunit Video Classroom Discussion	9:00 min.	7 - 15
C2	3		Class Discussion and Demonstration 6DM on Mechanical Power		
M	4		Student Exercises		17
			Math Skills Lab $6^{M}_{S}1$		19 - 23
L1	5		Lab 6 M1 Measuring Linear Mechanical Power Lab 6M2 Power in a Rotating Mechanical System		25 - 30
L2	6				31 - 38
R	7		Review of Mechanical Power		37
C1	8	FLUID SYSTEMS	Fluid Power Subunit Video Class Discussion	8:51 min.	39 - 48
C2	9		Class Discussion and Demonstration 6DF on Fluid Power		
M	10		Student Exercises		49
			Math Skills Lab $6^{M}_{S}2$		51 - 54
L1	11		Lab 6F1 - Fluid Power in Hydraulic Systems Lab 6F2 - Power from Air Motors		55 - 59
L2	12				61 - 67
R	13		Review of Fluid Power		68
C1	14	ELECTRICAL SYSTEMS	Electrical Power Subunit Video Class Discussion	6:32 min.	69 - 76
C2	15		Class Discussion and Demonstration 6DE on Electrical Power		
M	16		Student Exercises		77
			Math Skills Lab $6^{M}_{S}3$		79 - 82
L1	17		Lab 6E1 Measuring Electrical Energy with a Watt-Hour Meter Lab 6E2 - Electric Motors and Generators		83 - 87
L2	18				89 - 95
R	19		Review of Electrical Power		96
C1	20	THERMAL SYSTEMS	Thermal Power Subunit Video Class Discussion	3:06 min.	97
S	21	"Summary" of Unit 6, "Power"	Review of Thermal Power		100
			Summary video on "Power"		101
SUPPLEMENTAL		GLOSSARY	Please review.)		103
UNIT 6 TEST		END-OF-UNIT EXERCISES	Review of Objectives.)		105 - 106
SUPPLEMENTAL		DEMONSTRATIONS	(Instructions on setup.)		D-1 - D-13

Breakdown of Unit 7: 'Force Transformers'

Designator	Class	Subunit Title	Class Activity	Video Time	Student Text Page No.
O	1	Overview of Unit 7, "Force Transformers"	Overview video on "Force Transformers" Class Discussion	7.24 min.	1 - 6
C1	2	FORCE TRANSFORMERS IN LINEAR MECHANICAL SYSTEMS	Linear Mechanical F-TR Subunit video Classroom Discussion	8.24 min.	7 - 19
C2	3		Class Discussion and Demonstration TDML on F-TR		
M	4		Student Exercises		20
L1	5		Math Skills Lab $7\frac{M}{S}1$		23 - 29
L2	6		Lab 7M1 - "The Come-Along Winch"		31 - 36
R	7		Lab 7M2 - "The Screw"		37 - 41
C1	8	FORCE TRANSFORMERS IN ROTATIONAL MECHANICAL SYSTEMS	Review of Linear F-TR		42
C2	9		Rotational Mechanical F-TR Subunit Video Classroom Discussion	8.30 min.	43 - 55
M	10		Class Discussion and Demonstration TDMR on F-TR		
L1	11		Student Exercises		57
L2	12		Math Skills Lab $7\frac{M}{S}2$		59 - 64
R	13		Lab 7M3 - "Gears"		65 - 71
C1	14	FORCE TRANSFORMERS IN FLUID SYSTEMS	Lab 7M4 - "Belts and Pulleys"		72 - 78
C2	15		Review of Linear F-TR		79
M	16		Fluid F-TR Subunit Video Classroom Discussion	5.17 min.	81 - 89
L1	17		Class Discussion and Demonstration TDF on Fluid F-TR		
L2	18		Student Exercises		91
R	19		Math Skills Lab $7\frac{F}{S}3$		93 - 96
C1	20	FORCE TRANSFORMERS IN ELECTRICAL SYSTEMS	Lab 7F1 - "The Hydraulic Jack"		97 - 102
C2	21		Lab 7F2 - "The Pressure Transducer"		103 - 107
M	22		Review of Fluid F-TR		8
L1	23		Electrical F-TR Subunit Video Class Discussion	7.42 min.	109 - 114
L2	24		Class Discussion and Demonstration TDE on Electrical F-TR		
R	25		Student Exercises		8
S	26	Summary of Unit 7, "Force Transformers"	Summary video on F-TR	5.43 min.	121 - 123
		Glossary			124
		General Review of Units 5 - 7			125 - 139
UNIT 7 TEST		END OF UNIT EXERCISES	Review of Objectives		141 - 142
SUPPLEMENTAL		DEMONSTRATIONS	Instructions on setup		D1 - D10

TEACHING PATH - CLASS 0

RESOURCE MATERIALS

Video: "Overview: Force"
Student Text: "Overview: Force"

CLASS GOALS

When the students come to this class, they should have read the "Overview" of Unit . in the text. This information will be expanded and reinforced throughout the rest of Unit 1. In this class, you should help your students understand the following:

1. The definition of a force.
2. That technicians deal with four energy systems, which are:
   a. Mechanical
   b. Fluid
   c. Electrical
   d. Thermal
3. How **pressure** in fluid systems, **voltage** in electrical systems, and **temperature** in thermal systems each acts like a force, and is said to be a forcelike quantity called a "prime mover."

CLASS ACTIVITIES

1. Show the video, "Overview: Force." See back of this page for a summary of the video. Use suggested questions as a lead-in before turning on video. Use suggested discussion questions after video has been shown to emphasize video highlights.
2. Integrate ideas presented in the video with those discussed in the text.
3. Assign the text up to "What is Torque? How is Torque Related to Rotation?" to be read before coming to the next class--Class C1.

ABOUT THE VIDEO, "OVERVIEW: FORCE"

BEFORE THE VIDEO

Ask students the following question:

- What is the principal characteristic of a force or forcelike quantity (the prime mover)?

Tell students that they're going to see a video program about force. Students should pay attention to (1) the characteristics of forces, and (2) the ways pressure, voltage and temperature difference are similar to force. Pressure, voltage and temperature difference are called "forcelike quantities," because of these similarities.

SUMMARY OF THE VIDEO

This video segment introduces force as a push or pull that can cause change in the motion or shape of an object. Using examples from everyday life and the world of technology, the program shows that force can cause an object to start moving, stop moving--or to move in a different direction. A force can also change the shape of an object, as when a car is put into a crusher or when a person crushes a soft drink can.

Pressure, voltage and **temperature difference** are prime movers that act like forces. Each causes movement within its own kind of system: mechanical, fluid, thermal or electrical. Blood flows through our bodies and water flows through pipes because of **pressure. Voltage** causes the movement of electrons. This movement may be through wires and circuits, and--in part--makes possible the technology that allows us to produce video programs. Heat energy moves from warmer to colder areas because of temperature difference.

Because modern technology often combines mechanical, electrical, thermal and fluid systems in complex devices, technicians must understand all four systems and the similarities among the four prime movers--force, pressure, voltage and temperature difference.

DISCUSSION QUESTIONS ABOUT THE VIDEO

1. Describe a force. (A force is a push or a pull that can cause an object to move, continue to move, change direction, stop moving or slow down, or changes the shape of the object.)
2. What do force, pressure, voltage and temperature difference have in common? (They have the same function in different energy systems and act as prime movers.)
3. How does an understanding of forces help technicians? (All work is based on applying forces, so technicians must understand force as the prime mover in all systems.)

APPENDIX B

Occupational Information Guide

PRINCIPLES OF TECHNOLOGY

OCCUPATIONAL INFORMATION

	Page
OVERVIEW: OCCUPATIONAL INFORMATION	2
TECHNOLOGISTS AND TECHNICIANS	3
ELECTROMECHANICAL INSTRUMENTATION AND MAINTENANCE TECHNOLOGIES	5
ELECTRICAL AND ELECTRONIC TECHNOLOGIES	6
ENVIRONMENTAL CONTROL TECHNOLOGIES	7
CIVIL TECHNOLOGIES	9
ARCHITECTURAL TECHNOLOGIES	10
INDUSTRIAL PRODUCTION TECHNOLOGIES	11
QUALITY CONTROL AND SAFETY TECHNOLOGIES	13
MECHANICAL AND RELATED TECHNOLOGIES	15
MINING AND PETROLEUM TECHNOLOGIES	16
ALLIED HEALTH, DIAGNOSTIC, AND TREATMENT TECHNOLOGIES	17
BROADCAST TECHNICIANS	18
TECHNICAL WRITERS	20
NEW AND EMERGING TECHNICAL CAREERS	21

HOW TO USE THIS INFORMATION

This information is designed to be used with Principles of Technology to provide teachers and students with occupational information. This material should be used as teachers see the need when students desire occupational information. We hope the teacher will cover all the occupations with the students to assist them with career choices.

Phil Rollain
Project Coordinator

OVERVIEW: OCCUPATIONAL INFORMATION

The selection of an occupation is one of the most important decisions in a person's life. For the young preparing for a career, questions abound as to what skills are required in each field and how those skills may be attained or refined. Furthermore, while you may be aware of your own interests and abilities, you face the perplexing choice of selecting a field which promises the greatest economic and personal satisfaction.

How much training does it take to enter a particular occupation? Is experience important? How much can I expect to earn? Is it difficult to find a job in this field? Finding the answers can be difficult. However, more resources are available than ever before to help you make an informed career choice.

Each unit will contain occupational information on 46 different technical positions. The information shall be brief and to the point, and students desiring additional information should contact their guidance department or public library for these particular references:

1. Occupational Outlook Handbook, published and revised every two years by U.S. Department of Labor, Bureau of Labor Statistics.

2. Dictionary of Occupational Titles (D.O.T.) published by U.S. Department of Labor (fourth edition).

3. Many trade associations, professional societies, trade unions, industrial organizations, and state and federal government agencies are able to provide career information that is valuable and up to date.

4. North Carolina Careers is a microcomputerized, comprehensive career guidance system designed to find occupations that match the student's own personality characteristics and preferences. North Carolina Careers also provides in-depth, accurate, and up-to-date information on 300 occupations and 143 training sites.

   North Carolina Careers contains 141 different ways to describe oneself or to obtain concise information on occupations in 11 topic areas including:

   Interests
   Aptitudes
   Temperaments
   Education Level
   Environmental Conditions
   Employment Outlook
   Wage/Salary
   Hours of Work/Travel
   Physical Demands
   Physical Activities
   Indoor/Outdoor Considerations

Technologists and Technicians. Technologists and technicians provide the technical assistance necessary for engineering, computer, library, legal, and similar professional activities. They focus on the practical elements of a job, leaving the policy, theory, and design aspects to others.

Technologists and technicians perform the day-to-day tasks needed to carry out a project or run an operation. They may operate testing and measuring equipment in a laboratory; make drawings of new designs; build models of new projects; program computers; or guide airplanes to their destinations. They are employed in nearly every industry, wherever technical assistance in a specialized area is needed.

Most technologists and technicians work closely with and are supervised by professional workers; for example, engineering technicians work with engineers. They are usually part of a team that is engaged in a particular project or operation.

In most specialities, technologists and technicians use complex electronic or mechanical instruments, technical manuals, or other specialized materials. Because of the diversity of technologists and technician occupations, training requirements vary widely. A high school diploma is a minimum requisite; most jobs, in fact, require specialized postsecondary training. Training is offered at junior and community colleges, technical institutes, vocational schools, and extension divisions of colleges and universities. These programs usually emphasize practical courses and "hands-on" experience in a particular specialty. Programs vary in length. For example, most legal assistant programs require two years' work. On the other hand, programmers complete four-year bachelor's degree programs.

In addition to acquiring a formal education, technologists and technicians often receive on-the-job training; for example, programmers generally work under close supervision for several months. Occasionally, technologists and technicians take additional courses to keep abreast of technological advances in their specialty.

The knowledge and personal characteristics required in these jobs vary, but most technologists and technicians need a good foundation in mathematics and the basic sciences--physics, chemistry, and biology. They must be able to apply practical knowledge to solve particular problems. Because they are often part of a team, technologists and technicians must follow directions well and effectively communicate their findings to others. They must be patient, precise, and organized in their work habits. Also, most need manual dexterity to work with various kinds of equipment.

This course, Principles of Technology, is designed to give the student the first course in a technical career. It offers students a broad base of the principles and concepts of technology so that they can build on it in the years to come. This course helps students learn technological basics that enable them to respond to changes in the marketplace as their career paths unfold. The knowledge this course transmits is the basic information for an increasing variety of advanced technology occupations, some of which do not yet exist.

Electromechanical Instrumentation and Maintenance Technologies. A group of instructional programs that prepare individuals either to support or assist mechanical and electrical engineers, or to install and service electromechanical equipment. Programs stress specialized, practical knowledge related to the mechanical, mathematical, scientific, or technical aspects of mechanical and electrical engineering, biomedical engineering, computer science, and instrumentation design.

Biomedical Equipment Technology. An instructional program that prepares individuals to manufacture, install, calibrate, operate, and maintain sophisticated life-support equipment found in hospitals, medical centers, and research laboratories. Includes instruction in the use of testing and diagnostic instruments; calibrating techniques; potential hazards and safety precautions; and methods of installation, repair, maintenance, and operation of the equipment.

Computer Servicing Technology. An instructional program that prepares individuals to install, program, operate, maintain, service, and diagnose operational problems in computer systems arising from mechanical or electrical malfunctions in computer units or systems. Includes instruction in the underlying physical sciences and supporting mathematics of computer design, installation, construction, programming, operation, maintenance, and functional diagnosis, and how to detect, isolate, and correct malfunctions. Programs describe the electrical and electronic circuits and mechanical devices used in computer construction and their combination into systems in individual computers or computing installations, as well as instruments used to detect weaknesses or failures in electrical systems in computers.

Electromechanical Technology. An instructional program that prepares individuals to assist mechanical and electrical engineers and other managers in the design, development, and testing of electromechanical devices and systems such as plant automated control systems, servomechanisms, vending machines, elevator controls, missile controls, tape-control machines, and auxiliary computer equipment. Includes instruction in assisting with feasibility testing of engineering concepts; systems analysis (including design, selection, testing, and application of engineering data); and the preparation of written reports and test results.

Instrumentation Technology. An instructional program that prepares individuals to design, develop prototypes for, test, and evaluate control of measurement devices on systems, and to prepare graphs, written reports, and test results in support of the professional personnel working in the field of instrumentation. Includes instruction in the fields of electricity, electronics, mechanics, pneumatics, and hydraulics as they pertain to the principles of control, recording systems, automated devices, and the calibration of instrumentation units or systems.

Electrical and Electronic Technologies. A group of instructional programs that prepare individuals to support and assist electrical and electronic engineers, and other engineers and scientists concerned with the development of lasers. Programs stress specialized, practical knowledge related to the mechanical, mathematical, scientific, or technical aspects of electrical engineering, electronic engineering, and laser development.

Computer Technology. An instructional program that prepares individuals to support engineers and scientists in the design, development, and testing of computer and peripheral devices. Includes instruction in electronic circuitry; prototype development and testing; systems design, selection, installation, and testing; solid state and microminiature circuitry to data storage devices; and the preparation of reports and documentation of test results.

Electrical Technology. An instructional program that prepares individuals to support an electrical engineer in the design, development, and testing of electrical circuits, devices, and systems for generating electricity and distributing electrical power. Includes instruction in model and prototype development and testing; systems analysis and integration, including design and development of corrective and preventive maintenance techniques; application of engineering data; and the preparation of reports and test results.

Electronic Technology. An instructional program that prepares individuals to support the electronic engineer and other professionals in the design, development, modification, and testing of electronic circuits, devices, and systems. Includes instruction in practical circuit feasibility; prototype development and testing; systems analysis, including design, selection, installation, calibration, and testing; solid-state and microminiature circuits; and the application of engineering data to specific problems in the electronics field.

Laser Electro-Optic Technology. An instructional program that prepares individuals to assist engineers, scientists, or plant managers in the assembly, installation, testing, adjustment, and operation of various types of lasers for various applications. Includes instruction in safety precautions and the optical, physical, and chemical theory and application of each laser device.

Environmental Control Technologies. A group of instructional programs that prepare individuals to assist in controlling either the internal temperature of commercial and industrial buildings, or the levels of toxicity of industrial wastes.

Air Conditioning, Heating, and Refrigeration Technology. An instructional program that prepares individuals to work in engineering departments or independently as entrepreneurs capable of designing, installing, maintaining and operating small or medium air conditioning, heating, and refrigeration systems. Instruction prepares individuals to work in a commercial organization performing special tasks relating to design, assembly, installation, servicing, operation, and maintenance of heating or cooling systems, according to the standards of the American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. Includes instruction in air conditioning, heating, and refrigeration devices, equipment, techniques, and systems; evaluation of amount of heating, air conditioning, or refrigeration capacity needed to accomplish a particular task; and instruction in the maintenance and operation of a system that meets the requirements of the task.

Air Pollution Control Technology. An instructional program that prepares individuals to detect, measure, and control air pollution. Includes instruction in the chemistry of combustion from which the majority of polluting elements in the air are derived; the major sources of air pollution, such as internal combustion engines, power plants, and industrial or home use of fuels; methods of sampling smokestack; detection and source identification and analysis of air pollutants, both gaseous and particulate; and the construction, use, calibration, and maintenance of automatic samplers, recorders, and other analytical devices.

Energy Conservation and Use Technology. An instructional program that prepares individuals to support engineers or work independently to identify and measure quantities of energy used in heating and cooling or operating a facility or industrial process; assess efficiency in the use of energy or the amount lost through wasteful processes or lack of insulation; and prescribe remedial steps to conserve energy within the system. Includes instruction in the utilization and conversion of energy in its various forms; techniques for improving use or preventing loss of energy; and the quantification of the net minimum or optimum energy required in a given system or process.

Sanitation Technology. An instructional program that prepares individuals to support sanitarians, and others responsible for health and sanitation factors, by determining the nature and amount of bacteria and chemical contaminants in water, wastewater, and food processing. Includes instruction in sampling, culturing, and identifying

pathogenic or other organisms; determining the relative amounts of contaminants in food, soil, water, or other materials by taking samples and performing analyses using sophisticated chemical and biological equipment and procedures; and sanitation-related aspects of water and wastewater purification and processing systems and food processing, storage, and service. Programs prepare individuals for the licensure or certification that is required in some states for employment in government sanitation or health-related agencies.

Solar Heating and Cooling Technology. An instructional program that prepares individuals to work with heating, cooling, and refrigeration engineers and scientists in research, design, installation, and maintenance for maximum efficiency of solar heating units for space heating, cooling, and water heating for factory, home, or institutional use. Includes instruction in the design and dynamics of solar heat collecting systems; heat collection, storage, and distribution in modern heating and cooling systems; theory, procedures, and measuring devices for air conditioning, heating, and refrigeration systems; and the individual mechanisms and controls used in solar heat collecting units for air conditioning, heating, or refrigeration systems.

Water and Wastewater Technology. An instructional program that prepares individuals to process, purify, store, control pollution in, distribute, and dispose of wastewater. Includes instruction in the design, construction, operation, and maintenance of equipment for water or wastewater collection, processing pollution control, and distribution; operation of machines, devices, and control systems which use sophisticated modern instrumentation; testing of samples of materials at various stages in the process design; hydraulics; liquid collection; liquid-processing equipment; pumping and conveying; sampling and testing, both chemically and biologically; processes of purification digestion, biological deterioration, and disintegration of wastewater products; plant layout, operation, and safety; and the regulations and standards controlling water or wastewater purification.

Civil Technologies. A group of instructional programs that prepare individuals to support and assist civil engineers and urban planners. Programs stress specialized, practical knowledge related to the mathematical, scientific, or technical aspects of civil engineering and urban planning.

Civil Technology. A group of instructional programs that prepare individuals to assist a civil engineer in designing, surveying, materials control, testing, and building of various structures. Includes instruction in physical sciences; mathematics; surveying; laying out roadways; preparing plans and specifications for the construction of highways, railroads, buildings, dams, and airports; structural detailing and design testing; construction estimating; and operations management.

Drafting and Design Technology. An instructional program that prepares individuals to assist mechanical, electrical and electronic, architectural, chemical, civil, or other engineers in the design and drafting of electrical circuits, machines, structures, weldments, or architectural plans. Includes instruction in the preparation of engineering plans, layouts, and detailed drawings according to conventional projection principles and techniques or as specified; preparation of charts, graphs, or diagrams; model making; and the use of handbook data germane to design and drafting in various engineering fields.

Surveying and Mapping Technology. An instructional program that prepares individuals to technically assist civil engineers and urban planners in the determination and description of the shape, contour, location, and dimensions of geographic areas or features.

Urban Planning Technology. An instructional program that prepares individuals to work as team members with civil engineers, social scientists, and urban-planning professionals. Includes instruction in methods used in urban design and land utilization; methods of demographic study, including population growth, transportation in urban settings, and housing; building and construction codes and regulations; urban traffic management and control; distribution of water and wastewater systems; electrical systems relating to the overall planning for redevelopment of an urban area; urban mapping and engineering drawing; reading architectural or engineering drawings; methods of urban growth determination and projection; cost determination; analysis and comparison of different types of configurations and the sociological aspects of housing, transportation, recreation, park and living space, employment, and logistics in an urban setting.

Architectural Technologies. A group of instructional programs that prepare individuals to support and assist architects and architectural engineers. Programs stress specialized, practical knowledge related to the mathematical, scientific, or technical aspects of architecture and architectural engineering.

Architectural Design and Construction Technology. An instructional program that prepares individuals to assist the architect and architectural engineer in planning and designing structures and buildings; testing materials; constructing and inspecting structures; model building and design estimating; utilizing, transporting, and storing construction materials; and dealing with contracts and specifications.

Architectural Interior Design Technology. An instructional program that prepares individuals to assist architects in planning and designing interior layouts. Includes instruction in designing architectural structures; analyzing and using various types and colors of floor, wall, and ceiling coverings; windows and doors; accoustical materials; functional furnishings; electrical, heating, cooling, and other outlets; and in assessing costs related to design and furnishings.

Industrial Production Technologies. A group of instructional programs that prepare individuals to supervise industrial processes or to support engineers, scientists, and other professionals who are employed by industry. Programs describe the mechanical, scientific, or technical aspects of a variety of industries, including chemical, manufacturing, food processing, forest products, marine products, plastics, and textiles.

Chemical Manufacturing Technology. An instructional program that prepares individuals to support chemists in the chemical-manufacturing fields. Includes instruction in material handling, crushing, grinding and sizing; extraction, distillation, evaporation, drying absorption, and heat transfer; and assisting in design, installation, and operation of pilot plants for chemical-manufacturing processes.

Food Processing Technology. An instructional program that prepares individuals to assist food chemists and food-processing engineers in processing raw foodstuffs into marketable food products by selecting and grading raw materials, and by industrial processes for extracting, converting, drying, freezing, preserving, canning, pickling, smoking, radiating, chemically treating, and packaging products. Includes instruction in the basic sciences and supporting mathematics of chemistry, microbiology, and physics as they relate to food processing, and in the processes, equipment, sanitation, inspection, handling procedures and techniques, process control and scheduling, product storage, shipping and cost analyses of alternative processes in the industry as applied to specific products and localities.

Industrial Technology. An instructional program that prepares individuals to assist an industrial engineer in production and planning; design and installation of integrated systems of materials, equipment, and personnel; and measurement, testing, and management of quality control in the manufacturing, transportation, assembly, installation, and operation of processes and products. Includes instruction in the operating of testing equipment (destructive and nondestructive), measuring devices, specification reading, and design and measurement for levels of tolerance compatible with overall production specifications.

Manufacturing Technology. An instructional program that prepares individuals to technically assist in the optimization of the design, construction, and application of machinery tools, equipment, and processes used in the production of goods.

Marine Products Technology. An instructional program that prepares individuals to supervise processing of marine products, including seaweed, non-vertebrate and vertebrate marine products. Includes instruction in the anatomy and identification of marine products; the construction, mechanics, and operation of equipment; procedures, techniques, and sanitation aspects of processing, including refrigeration and

chemical preservation; safe working practices; sanitation and inspection; and potential chemical, biological, or bacteriological problems encountered, including any pathological condition of the product during processing.

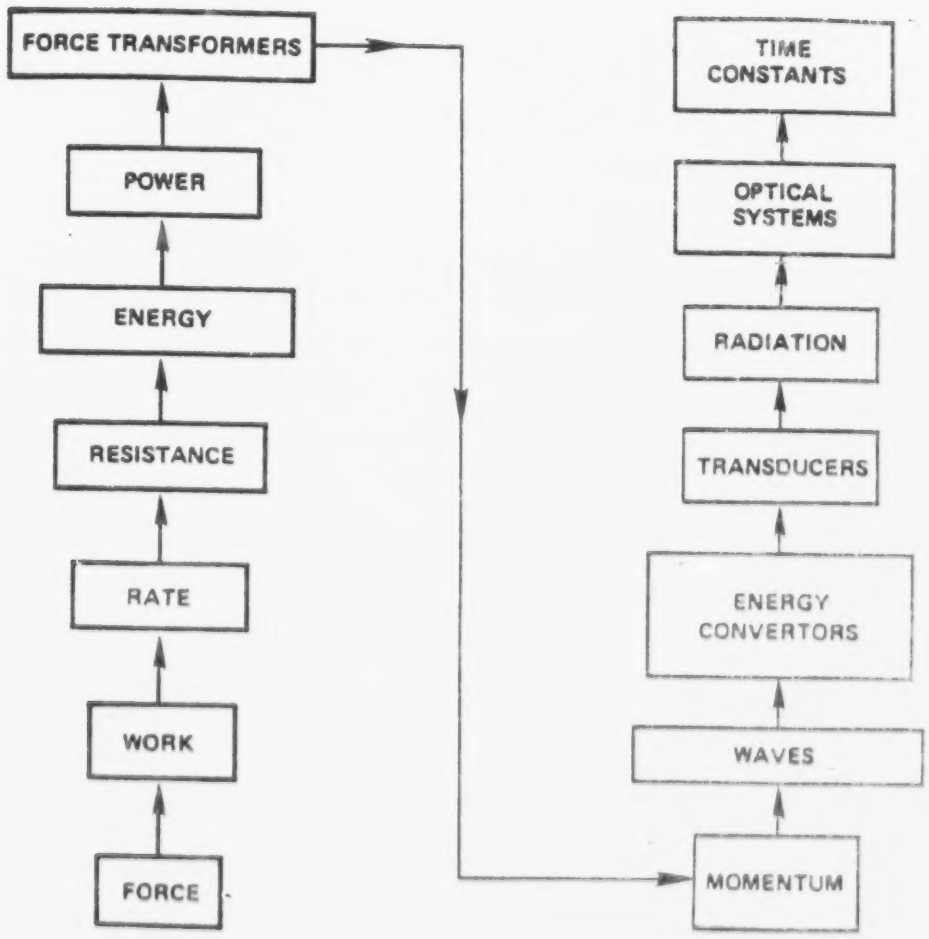
Optical Technology. An instructional program that prepares individuals to grind lenses from optical glass or from modern plastic, according to engineering specifications or optometrist prescriptions. Includes instruction in the science of optics, optical glass, and plastics used in optics; optical design and drawing; machinery, materials, and techniques required for production of optical lenses; and in the polishing of lenses or optical elements for mounting in eyeglasses or holding devices.

Plastic Technology. An instructional program that prepares individuals to support plastic design engineers, scientists, managers, or entrepreneurs in the application, production, and fabrication of plastic products. Includes instruction in the chemistry and applied engineering sciences related to thermosetting, pressing, forming, molding, and producing of fiberglass or other plastics; drawings for dies, form molds, or plastic assemblies; molding, extruding, jointing, finishing, inspecting, and controlling the quality of the products; packaging for shipment or storage; and hazards associated with production and design.

APPENDIX C

Overview of Principles of Technology

OVERVIEW OF PRINCIPLES OF TECHNOLOGY



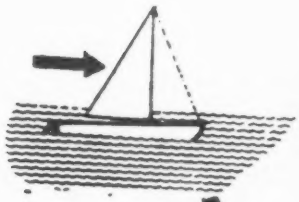
UNIT 1

FORCE

FORCELIKE QUANTITIES CAUSE MOVEMENT OF MASS, CHARGE OR ENERGY

MECHANICAL

TRANSLATIONAL — FORCE CAUSES LINEAR DISPLACEMENT OF MASS



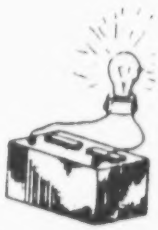
ROTATIONAL — TORQUE CAUSES ANGULAR DISPLACEMENT OF MASS

FLUID

PRESSURE DIFFERENCE CAUSES DISPLACEMENT OF VOLUME OF FLUID

ELECTRICAL

VOLTAGE DIFFERENCE CAUSES DISPLACEMENT OF CHARGE



THERMAL

TEMPERATURE DIFFERENCE CAUSES DISPLACEMENT OF HEAT ENERGY

UNIT 2

WORK

WORK RESULTS WHEN A FORCELIKE QUANTITY CAUSES A DISPLACEMENT.
THE UNIFYING EQUATION FOR WORK IS -

WORK DONE = ENERGY TRANSFERRED

WORK = FORCELIKE QUANTITY X DISPLACEMENTLIKE QUANTITY

MECHANICAL

TRANSLATIONAL	WORK = FORCE X DISPLACEMENT
ROTATIONAL	WORK = TORQUE X ANGLE OF ROTATION

FLUID

WORK = PRESSURE DIFFERENCE X FLUID VOLUME DISPLACED

ELECTRICAL

WORK = VOLTAGE DIFFERENCE X CHARGE TRANSFERRED

UNIT 3

RATE

RATE IS THE RATIO OF THE CHANGE IN A DISPLACEMENTLIKE QUANTITY TO THE TIME REQUIRED FOR THAT CHANGE.
THE UNIFYING EQUATION FOR RATE IS -

$$\text{RATE} = \frac{\text{DISPLACEMENTLIKE QUANTITY}}{\text{ELAPSED TIME}}$$

MECHANICAL

TRANSLATIONAL

$$\text{VELOCITY} = \frac{\text{DISPLACEMENT}}{\text{ELAPSED TIME}}$$

$$\text{ACCELERATION} = \frac{\text{CHANGE IN VELOCITY}}{\text{ELAPSED TIME}}$$

ROTATIONAL

$$\text{ANGULAR VELOCITY} = \frac{\text{ANGULAR DISPLACEMENT}}{\text{ELAPSED TIME}}$$

$$\text{ANGULAR ACCELERATION} = \frac{\text{CHANGE IN ANGULAR VELOCITY}}{\text{ELAPSED TIME}}$$

FLUID

$$\text{VOLUME FLOW RATE} = \frac{\text{VOLUME DISPLACED}}{\text{ELAPSED TIME}}$$

$$\text{MASS FLOW RATE} = \frac{\text{MASS DISPLACED}}{\text{ELAPSED TIME}}$$

ELECTRICAL

$$\text{CURRENT} = \frac{\text{CHARGE TRANSFERRED}}{\text{ELAPSED TIME}}$$

THERMAL

$$\text{HEAT FLOW RATE} = \frac{\text{HEAT ENERGY TRANSFERRED}}{\text{ELAPSED TIME}}$$

UNIT 4

RESISTANCE

RESISTANCE IS AN OPPOSITION TO MOTION AND CAUSES MOTION TO EVENTUALLY CEASE IF NO FORCELIKE QUANTITIES ARE PRESENT TO SUSTAIN IT.

THE UNIFYING EQUATION FOR RESISTANCE IS -

$$\text{RESISTANCE} = \frac{\text{FORCELIKE QUANTITY}}{\text{RATE}}$$

MECHANICAL

UNLIKE OTHER FORMS OF RESISTANCE, FRICTION IS NOT DEPENDENT UPON RATE.

FRICTIONAL FORCE = COEFFICIENT OF FRICTION X NORMAL FORCE

$$\text{DRAG RESISTANCE} = \frac{\text{DRAG FORCE}}{\text{SPEED}}$$

FLUID

$$\text{FLUID RESISTANCE} = \frac{\text{PRESSURE DIFFERENCE}}{\text{FLOW RATE}}$$

ELECTRICAL

$$\text{ELECTRICAL RESISTANCE} = \frac{\text{VOLTAGE DIFFERENCE}}{\text{RATE}} = \frac{\text{VOLTAGE}}{\text{CURRENT}}$$

THERMAL

$$\text{THERMAL RESISTANCE} = \frac{\text{TEMPERATURE DIFFERENCE}}{\text{HEAT FLOW RATE}}$$

THE ENERGY USED TO OVERCOME RESISTANCE IN MECHANICAL, FLUID, AND ELECTRICAL SYSTEMS IS CONVERTED INTO HEAT

UNIT 5
ENERGY

POTENTIAL ENERGY IS THE ENERGY OF POSITION. KINETIC ENERGY IS THE ENERGY OF MOTION. THE FOLLOWING ARE EXAMPLES OF POTENTIAL AND KINETIC ENERGY.

MECHANICAL

POTENTIAL ENERGY

GRAVITATIONAL	$E_p = mgh$
SPRING	$E_p = 1/2\ kd^2$

KINETIC ENERGY

TRANSLATIONAL	$E_K = 1/2\ mv^2$
ROTATIONAL	$E_K = 1/2\ I\omega^2$

FLUID

GRAVITATIONAL POTENTIAL ENERGY	$E_p = (\rho V)gh = mgh$
KINETIC ENERGY	$E_K = 1/2(\rho V)v^2 = 1/2\ mv^2$

ELECTRICAL

POTENTIAL ENERGY STORED IN A	$E_p = 1/2\ CV^2$
CAPACITOR C AND INDUCTOR L	$E_p = 1/2\ LI^2$

THERMAL

THERMAL ENERGY IS THE TOTAL KINETIC ENERGY OF MOVING MOLECULES

THE PRINCIPLE OF CONSERVATION OF ENERGY STATES THAT THE FORM OF ENERGY MAY BE CHANGED BUT ENERGY CAN BE NEITHER CREATED NOR DESTROYED. THE TOTAL ENERGY OF A CLOSED SYSTEM IS CONSTANT.

UNIT 6

POWER

POWER IS THE RATE OF DOING WORK. THE UNIFYING EQUATIONS OF POWER ARE -

$$\text{POWER} = \frac{\text{WORK (ENERGY)}}{\text{TIME ELAPSED}} \quad \text{OR} \quad \text{POWER} = \text{FORCELIKE QUANTITY} \times \text{RATE}$$

MECHANICAL

TRANSLATIONAL

$$\text{POWER} = \frac{\text{MECHANICAL WORK}}{\text{TIME}}$$

$$\text{POWER} = \text{FORCE} \times \text{SPEED}$$

ROTATIONAL

$$\text{POWER} = \frac{\text{MECHANICAL WORK}}{\text{TIME}}$$

$$\text{POWER} = \text{TORQUE} \times \text{ANGULAR SPEED}$$

FLUID

$$\text{POWER} = \frac{\text{FLUID WORK}}{\text{TIME}}$$

$$\text{POWER} = \text{PRESSURE} \times \text{FLOW RATE}$$

ELECTRICAL

$$\text{POWER} = \frac{\text{ELECTRICAL WORK}}{\text{TIME}}$$

$$\text{POWER} = \text{VOLTAGE} \times \text{CURRENT}$$

THERMAL

$$\text{POWER} = \frac{\text{HEAT ENERGY}}{\text{TIME}}$$

UNIT 7

FORCE TRANSFORMERS

FORCE TRANSFORMERS ARE DEVICES THAT TRANSFORM FORCELIKE QUANTITIES AND DISPLACEMENTLIKE QUANTITIES. THE UNIFYING EQUATION FOR IDEAL FORCE TRANSFORMERS IS -

ENERGY IN = ENERGY OUT

OR

INPUT FORCELIKE QUANTITY X INPUT DISPLACEMENTLIKE QUANTITY = OUTPUT FORCELIKE QUANTITY X OUTPUT DISPLACEMENTLIKE QUANTITY

MECHANICAL

TRANSLATIONAL	FORCE IN X DISPLACEMENT IN = FORCE OUT X DISPLACEMENT OUT
ROTATIONAL	TORQUE IN X ANGULAR DISPLACEMENT IN = TORQUE OUT X ANGULAR DISPLACEMENT OUT

FLUID

PRESSURE IN X VOLUME DISPLACEMENT IN = PRESSURE OUT X VOLUME DISPLACEMENT OUT

ELECTRICAL

VOLTAGE IN X CURRENT IN = VOLTAGE OUT X CURRENT OUT

THE CONCEPT OF FORCE TRANSFORMERS IS NOT APPLIED TO THERMAL SYSTEMS.

LAB AND DEMO EQUIPMENT – YEAR ONE

UNIT NO.	UNIT SUBJECT	SUBUNIT				NO. OF TEACHER DEMOS	NO. OF STUDENT LABS
		MECHANICAL	FLUID	ELECTRICAL	THERMAL		
1	FORCE	√	√	√	√	4	8
2	WORK	√	√	√		3	6
3	RATE	√	√	√	√	4	8
4	RESISTANCE	√	√	√	√	4	8
5	ENERGY	√		√	√	4	8
6	POWER	√	√	√		3	6
7	FORCE TRANS-FORMERS	√	√	√		3	7
					TOTAL NUMBER	28	51

PRINCIPLES OF TECHNOLOGY

EQUIPMENT LIST FOR YEAR ONE

- CONSISTS OF 111 ITEMS
  - LISTS 90% TO 95% OF ALL EQUIPMENT NEEDED FOR STUDENT LABS
  - 21 ITEMS (OR 19%) ARE USED IN ONE LAB
  - 16 ITEMS (14%) ARE USED IN TEN OR MORE LABS
  - 44 ITEMS (40%) ARE USED IN FOUR OR MORE LABS
  - 54 ITEMS FROM YEAR ONE WILL BE USED AT LEAST ONCE IN YEAR TWO

- COST ESTIMATE FOR 1 LAB STATION THAT CAN ACCOMMODATE ALL 51 LABS

  $5,200 TO $5,400

- COST ESTIMATE FOR ADDITIONAL DEMONSTRATION EQUIPMENT FOR ALL 28 DEMONSTRATIONS

  $1,100 TO $1,300

WHAT MATH SKILLS ARE NEEDED FOR PRINCIPLES OF TECHNOLOGY

192

66-21

MATH SKILLS FOR STUDENTS

PERCENTAGES

FRACTIONS TO DECIMALS

DECIMALS TO PERCENTAGES

HANDLING FRACTIONS

ADD AND SUBTRACT

MULTIPLY AND DIVIDE

SCIENTIFIC NOTATION

BASE TEN

NUMBER TO POWER-OF-TEN

POWER-OF-TEN TO NUMBER

ADD, SUBTRACT, MULTIPLY, DIVIDE WITH POWER-OF-TEN NUMBERS

LEARN/USE METRIC PREFIXES

USE ELECTRONIC CALCULATORS

DRAW TO SCALE/INTERPRET SCALES

GIVEN A SCALE UNIT, DRAW A GIVEN QUANTITY (15 POUNDS, EAST; 20 MPH, NORTH) TO THAT SCALE.

GIVEN A PHYSICAL QUANTITY DRAWN TO A GIVEN SCALE, OBTAIN MAGNITUDE/DIRECTION OF GIVEN QUANTITY.

MATH SKILLS FOR STUDENTS

GRAPHING

GIVEN DATA, DRAW GRAPH

GIVEN GRAPH, READ OFF DATA

LINEAR VARIATION

NON-LINEAR VARIATION

HANDLING NUMBERS WITH UNITS

AREA = 4 FT^2

VOLUME = 6 CM^3

CIRCUMFERENCE = 2 INCHES

ANGLE = 3.14 RADIANS

SPEED = 20 M/SEC

PRESSURE = 14.7 PSI

LENGTH MEASURE

LINEAR MEASURE (ENGLISH/METRIC)

- FRACTIONAL DIVISIONS
- READ LINEAR SCALES
- READ COMPRESSED SCALES
- SELECT FROM AMONG MULTIPLE SCALES (E.G., MULTIMETER SCALE

CIRCULAR MEASURE (ENGLISH/METRIC)

- PERIMETER
- ARC LENGTH
- CIRCUMFERENCE ($C = 2\pi R$)

ESTIMATE READINGS

MATH SKILLS FOR STUDENTS

ANGULAR MEASURE (DEGREES/RADIANS)

USE A PROTRACTOR

READ/DRAW ANGLES IN DEGREES

CONVERT DEGREES TO RADIANS

CONVERT RADIANS TO DEGREES

AREA MEASURE/UNITS

SQUARE: $A = L^2$

RECTANGLE: $A = L \times W$

CIRCLE: $A = \pi R^2 = \frac{\pi D^2}{4} = 0.7854\ D^2$

TRIANGLE: $A = \frac{1}{2}\ B \times A$

VOLUME MEASURE

BOX: $V = L \times W \times H$

CYLINDER: $V = \pi R^2 \times H$

SPHERE: $V = \frac{4\pi R^3}{3}$

CONVERT UNITS

$10\ FT^2$ TO $\underline{\ ?\ }\ IN^2$

$$10\ FT^2 \times \frac{144\ IN^2}{1\ FT^2} = (10 \times 144)\left(\frac{\cancel{FT^2} \cdot IN^2}{\cancel{FT^2}}\right) = 1440\ IN^2$$

$20\ kg$ TO $\underline{\ ?\ }\ gm$

$$20\ kg \times \frac{1000\ gm}{kg} = (20 \times 1000)\left(\frac{\cancel{kg} \cdot gm}{\cancel{kg}}\right) = 2 \times 10^4\ gm$$

MATH SKILLS FOR STUDENTS

LEARN DIMENSIONAL ANALYSIS

$$\text{DIST} = (\text{SPEED})(\text{TIME}) + \frac{1}{2}(\text{ACC})(\text{TIME})^2$$

$$\text{FT} = \frac{\text{FT}}{\cancel{\text{SEC}}} \times \cancel{\text{SEC}} + \frac{1}{2} \times \frac{\text{FT}}{\cancel{\text{SEC}^2}} \times \cancel{\text{SEC}^2}$$

$$\text{FT} = \text{FT} + \text{FT}$$

$$\text{FT} = \text{FT} \quad \text{(CHECK!)}$$

WORD EQUATIONS TO SYMBOL NOTATION

$$\text{PRESSURE} = \frac{\text{FORCE}}{\text{AREA}} \longrightarrow P = \frac{F}{A}$$

KINETIC ENERGY = ONE-HALF MASS TIMES SPEED SQUARED

$$KE = \frac{1}{2} MV^2$$

DIRECT SUBSTITUTIONS IN EQUATIONS

TORQUE = FORCE X LEVER ARM

$$\tau = F \times L$$

$$\tau = 40 \text{ LB} \times 2 \text{ FT} = (40 \times 2) \text{ LB}\cdot\text{FT} = 80 \text{ LB}\cdot\text{FT}$$

FORCE = PRESSURE X AREA

$$F = P \times A$$

$$F = 40 \frac{\text{LB}}{\text{IN}^2} \times 2 \text{ IN}^2 = (40 \times 2)\left(\frac{\text{LB}\cdot\cancel{\text{IN}^2}}{\cancel{\text{IN}^2}}\right) = 80 \text{ LB}$$

$$\text{DRAG RESISTANCE} = \frac{\text{DRAG FORCE}}{\text{SPEED}}$$

$$R_D = \frac{F_D}{V}$$

$$R_D = \frac{20 \text{ N}}{40 \frac{\text{M}}{\text{S}}} = \frac{20}{40}\left\{\frac{\text{N}}{1} \cdot \frac{\text{S}}{\text{M}}\right\} = 0.5 \frac{\text{N}\cdot\text{S}}{\text{M}}$$

MATH SKILLS FOR STUDENTS

REARRANGE SIMPLE EQUATIONS TO ISOLATE A VARIABLE

- $F = P \times A$ — SOLVE FOR P; SOLVE FOR A
- $R = \frac{\Delta V}{I}$ — SOLVE FOR ΔV; SOLVE FOR I
- $KE = \frac{1}{2} MV^2$ — SOLVE FOR V

RATIO/PROPORTION

DEFINE/DISCUSS MEANING OF RATIO: $\frac{A}{B}$ OR A:B

DEFINE EQUALITY OF TWO RATIOS (PROPORTION):

$$\frac{A}{B} = \frac{C}{D} \text{ OR } A:B :: C:D$$

RIGHT-ANGLE TRIGONOMETRY

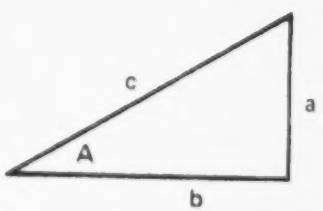
$\text{SIN } A = \frac{a}{c}$

$\text{COS } A = \frac{b}{c}$

$\text{TAN } A = \frac{a}{b}$

$a^2 + b^2 = c^2$

USE CALCULATOR



LOGS/EXPONENTS

BASE 10

BASE e

$I = I_0 e^{-\alpha X}$

$\alpha = -\frac{1}{X} \text{LOG}_e \left(\frac{I}{I_0}\right)$

MATH SKILLS FOR STUDENTS

SIGNIFICANT FIGURES (ROUGHLY)

$$P = \frac{F}{A} = \frac{10.\overline{2}\ N}{2.32518\ M^2} = 4.386757154\ \frac{N}{M^2}$$

$$= 4.3\overline{9}\ \frac{N}{M^2}$$

PRACTICE READING/SOLVING "STORY PROBLEMS"

WORK SIMPLE STORY PROBLEMS THAT REQUIRE SEVERAL CALCULATIONS TO GET FINAL ANSWER

A. $I = \frac{\Delta V}{R}$ (CALCULATE CURRENT FROM VOLTAGE AND RESISTANCE)

B. $Q = I \times t$ (CALCULATE CHARGE MOVED FROM CURRENT AND TIME)

APPENDIX D

RESOURCES

1. Curriculum Guides and Bulletins
2. Related Textbooks and Laboratory Manuals
3. Films, Filmstrips, Slide/tape Programs, Transparencies, Videotapes
4. Professional Organizations
5. Government Agencies
6. Industry
7. Journals

APPENDIX D 1

1. La. State Department of Education, Physical Science Curriculum Guide - Bulletin 1644. 1984. La. Department of Education, Baton Rouge, LA.

2. La. State Department of Education, Physics Curriculum Guide - Bulletin 1661. 1984. La. State Department of Education, Baton Rouge, LA.

3. La. State Department of Education, Basic Electricity/Electronics (Industrial Arts), Bulletin No. 1724.

4. La. State Department of Education, Advanced Electronics (Industrial Arts), Bulletin No. 1778. 1986.

5. Michigan State Board of Education, Robotics (Michigan Industrial Arts Curriculum).

6. La. State Department of Education, Power/Energy (Industrial Arts), Bulletin 1723.

7. La. State Department of Education, General Safety Manual for Vocational Technical Ed. and Industrial Arts Programs, Bulletin No. 1674. 1982.

Audiovisual Suppliers, continued

BFA-Ealing Corporation
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

BFA-Ealing Corporation
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

Beckman Instruments, Inc.
Attention: New Dimensions
2500 Harbor Boulevard
Fullerton, California 92634

Coronet Films
65 East South Water Street
Chicago, Illinois 60601

Education Audio-Visual, Inc.
Pleasantville, New York 10570

Encyclopaedia Britannica
Educational Corp.
425 North Michigan Avenue
Chicago, Illinois 60611

Educational Space Science Resource Center
2719 Airline Drive North
Bossier City, Louisiana 71111
(318) 746-7754

International Communication Films
1371 Reynolds Avenue
Santa Ana, California 92705

John Wiley and Sons, Inc.
605 Third Avenue
New York, New York 10016

Kalmia
Department C1
Concord, Massachusetts 01742

Lansford Publishing Co.
Post Office Box 8711
1088 Lincoln Avenue
San Jose, California 95155

McGraw-Hill Films
CRM/McGraw-Hill
110 15th Street
Del Mar, California 92014

Modern Learning Aids
1212 Avenue of the Americas
New York, New York 10036

Modern Talking Picture Service
St. Petersburg, Florida

APPENDIX D 3

Professional Organizations

Aviation Maintenance Foundation
Post Office Box 739
Basin, Wyoming 82410

Association of Home Appliance Manufacturers
20 North Wacker Drive
Chicago, Illinois 60606

Automotive Service Industry Association
230 North Michigan Avenue
Chicago, Illinois 60601

Air Line Pilots Association, International
1625 Massachusetts Avenue, N.W.
Washington, D.C. 20036

American Astronomical Society
211 Fitz Randolph Road
Princeton, New Jersey 08540

National Association of Broadcasters
1771 North Street, N.W.
Washington, D.C. 20036

(Public and Private Agencies)

American Vocational Association
2020 N. 14th Street
Arlington, Virginia 22201

American Public Power Association
2000 Virginia Avenue, N.W.
Washington, D.C. 20037

A local electrical company or a
licensed electrician

Airline Pilots Association International
1625 Massachusetts Avenue, N.W.
Washington, D.c. 20250

International Association of Machinists
and Aerospace Workers
1300 Connecticut Avenue, N.W.
Washington, D.C. 20036

American Petroleum Institute
2101 L Street, N.W.
Washington, D.C. 20037

Citizen Energy Project
1110 Sixth Street, N.W.
Washington, D.C. 20001

American Academy of Forensic Sciences
Suite 501, 11400 Rockville Pike
Rockville, Maryland 10852

American Federation of Musicians
1500 Broadway
New York, New York 10036

Opticians Association of America
1250 Connecticut Avenue, N.W.
Washington, D.C. 20036

American Institute of Physics
335 East 45th Street
New York, New York 10017

National Institute of Uniform Licensing
of Power Engineers
176 West Adam Street
Suite 1914
Chicago, Illinois 60603

National Science Teacher's Association
1742 Connecticut Avenue, N.W.
Washington, D.C. 20009

Professional Photographers of America, Inc.
1090 Executive Way
Des Plaines, Illinois 60018

Piano Technicians Guild
Post Office Box 1813
Seattle, Washington 98111

American Trucking Associations, Inc.
1616 P Street, N.W.
Washington, D.C. 20036

International Technology Education Association
1914 Association Drive
Reston, Virginia 22091

APPENDIX D 4

U. S. Government Agencies

U.S. Department of Energy
Department of Marketing and Education
Washington, D.C. 20545

National Space Technology Laboratories
Bay St. Louis, Mississippi
NASA Films, publications

U. S. Department of Energy Film Library
P. O. Box 62
Oak Ridge, Tennessee 37830

207

Quality Control and Safety Technologies. A group of instructional programs that prepare individuals to support a variety of engineers and industrial managers. Programs describe the mechanical, scientific, or technical aspects of industrial production, occupational health, and quality control.

Occupational Safety and Health Technology. An instructional program that prepares individuals to work with safety engineers and managers in analyzing working conditions in places of employment to ensure maximum safety to workers and occupants. Includes instruction in safety engineering principles and science; related federal, state, and local legislation; procedures, practices, techniques, and methods used in analyzing all aspects of working conditions in an employment establishment, including physical, water, atmospheric, and other environmental elements which may constitute hazards; determination of potentially unsafe working practices; chemical contamination of workers through the air they breathe; methods for correcting unsafe conditions or preventing them; cost analysis of various corrective measures for working conditions or practices on the job; capability in reading engineering drawings; and use of orthographic projection practices in drawing, diagramming, or sketching safety devices or plant layouts.

Quality Control Technology. An instructional program that prepares individuals to support engineers or managers by utilizing the sciences of measurement and quality control, quality design, production and inspection, testing (both destructive and nondestructive), statistical sampling, and mathematical probability as it relates to quality control in mass-produced items manufactured by modern production procedures and processes. Includes instruction in the intensive study of the physical and related engineering sciences and supporting mathematics related to material testing devices; testing; inspection techniques; organization of systems of quality control; statistical sampling; management of quality in manufacturing, transportation, assembly, installation, and operation; assurances of maximum accuracy or quality control in all phases of manufacturing; and utilization of all components and units in modern sophisticated machine devices or systems. Special study is required to understand the operation of testing equipment (particularly nondestructive equipment), measuring devices, reading of specifications, design and measuring of tolerances to assure that a certain level of quality will be met in producing a component, unit, or system. Includes instruction in the preparation of scientific or technical reports and in the development of interpersonal skills required in the performance of tasks or in the supervision of the work of others.

Safety Technology. An instructional program that prepares individuals to technically assist in the maintenance of materials, equipment, and personnel for industrial, commercial, and fire safety systems.

Textile Technology. An instructional program that prepares individuals to assist scientists, engineers, or managers in the textile industry or in related research, development, production, or servicing. Includes instruction in the nature and characteristics of textile fibers; spinning, weaving, dyeing, mordanting, fireproofing and static arresting, testing of fibers for tensile strength, heat resistance, crease resiliency, and laundering; equipment and machines used in marking textiles; and textile production, packaging, storage, shipment, and uses.

Welding Technology. An instructional program that prepares skilled workers at the technician level to understand, perform, and supervise or inspect a wide variety of welding processes. These include gas welding, brazing, flame cutting, metallic arc welding (manual or automatic), metallic gas or inert gas welding of ferrous and nonferrous materials, resistance welding, and fusing of glass and plastics in a welding mode. Includes instruction in the applied physics and metallurgy of the various welding processes and techniques, the composition and metallurgy of the various metals, the chemistry and physics of the welding process, the shielding elements in the welding processes, and the various types of equipment used to accomplish each process. Programs develop an elemental understanding of design for welding fabrication; an understanding of the elements of cost and economics of welding of various types; a knowledge of the methods of nondestructive inspection of welding and welded products; and an understanding of auxiliary equipment used in the process, such as jigs, fixtures, and annealing equipment related to welding.

Mechanical and Related Technologies. A group of instructional programs that prepare individuals to support and assist a variety of engineering professionals, including aeronautical, agricultural, automotive, mechanical, electrical and electronic, architectural, chemical, civil, mining, and petroleum engineers. Programs describe the mathematical, mechanical, scientific, and technical aspects of these engineering specialities.

Aeronautical Technology. An instructional program that prepares individuals to assist the aeronautical engineer in collecting research data relevant to the operation of aircraft and the design, testing, and development of propulsion, control, and guidance of aircraft and aerospace vehicles.

Agricultural Equipment Technology. An instructional program that prepares individuals to assist agricultural engineers. Includes instruction in farm machinery, farm structures, and rural electrification.

Automotive Technology. An instructional program that prepares individuals to support an automotive engineer in diagnosing normal or abnormal operation and in maintaining and repairing automotive equipment. Includes instruction in the installation, maintenance, operation, repair, adjustment or modification of automobiles, trucks, buses, and light industrial or farm equipment powered by gasoline, diesel, or turbine engines and equipped with electrical, hydraulic, pneumatic, or mechanical controls. Also includes instruction in the use and calibration of diagnostic and testing instruments and equipment.

Marine Propulsion Technology. An instructional program that prepares individuals to support propulsion engineers, ship officers, and managers of marine units and fleets, or to work as manufacturers' representatives of marine propulsion units. Includes instruction in various marine propulsion units and systems and their related controls; various fuels and fuel systems, and problems and hazards involved in their use; power capacity of various units; the basic design, installation, operation and maintenance, and servicing of various marine propulsion units and systems; the use and design of cooling systems; operational controls; cost efficiency of various alternative propulsion systems; and maintaining operation and service logs.

Mechanical Design Technology. An instructional program that prepares individuals to assist a mechanical design or equipment-systems engineer in designing, detailing, producing, and testing machines, using appropriate available materials, processes, techniques, and facilities. Includes instruction in drafting; strength of materials; manufacturing or fabrication procedures and practices; material testing; component inspection; machine or unit operation; evaluation; basic physics and mechanics and the supporting mathematics; basic mechanisms; hydraulics and pneumatics; quality control and testing; machine design; materials; specification preparation; and technical reporting.

Mining and Petroleum Technologies. A group of instructional programs that prepare individuals to support and assist mining and petroleum engineers and managers. Programs stress specialized, practical knowledge related to the mechanical, scientific, or technical aspects of mining and petroleum engineering.

Coal Mining Technology. An instructional program that prepares individuals to assist mining engineers or managers or to assume responsibility with a degree of independence in various aspects of mining operation. Includes instruction in methods, equipment, processes, techniques, and procedures employed in underground coal mining or in strip mining; coal beneficiation and conditioning for marketing; mapping and planning the exploitation of a coal field; managing for safe mining operations; disposing of mine waste; reclaiming strip-mine areas after coal has been removed; testing and analyzing the quality of coal; measuring the levels of impurities in air in mines and identifying the nature of the impurities; constructing, operating, and maintaining specialized machinery and equipment; and planning for maximum exploitation of deposits of coal by the most economical modern methods.

Mining (Excluding Coal) Technology. An instructional program that prepares individuals to work in a supportive role to mining engineers and managers in the development and exploitation of metal or other mineral ore deposits (excluding coal and other fossil fuels). Includes instruction in elementary geology; mechanical drawing and drafting; mining methods, both open pit and underground; surveying as it applies to planning the mining of a particular ore body; mining machinery; equipment and methods used in drilling, blasting, conveying, hoisting, crushing, and beneficiation; mine safety; environmental impact; production, storage, and disposal of solid or liquid wastes; and collecting, screening, filtering, drying, processing, storing, and shipping of finished ore.

Petroleum Technology. An instructional program that prepares individuals to assist in petroleum production; on-shore or off-shore exploring for petroleum fields; seismic testing of promising geological formations; drilling test wells; improving drilling technology; analyzing cores from drilling; logging cores; collecting petroleum from producing wells; delivering oil to holding points or pipelines for transporting to refineries; or capturing gas and retaining it in holding points for marketing. Includes instruction in the methods for increasing productivity of oil fields; seismic exploration; sophisticated scientific and production methods; instrumentation, machinery, equipment, techniques, and processes used in obtaining and refining crude oil into salable products; oil- or gas-well drilling; oil- or gas-well control by use of drilling muds or other techniques; charting and diagraming oil fields, oil wells, and pipelines; and designing refineries.

Allied Health, Diagnostic, and Treatment Technologies. A partial list of instructional programs that prepare individuals to assist a qualified health professional in providing diagnostic, therapeutic, preventive, restorative, and rehabilitative services. Many times in the health care field a technician is expected and/or required to make minor repairs on his/her equipment.

Cardiopulmonary Technology. An instructional program that prepares individuals to perform a wide range of tests related to the functions and therapeutic care of the heart-lung system; operate and maintain a heart-lung machine for extra-corporeal circulation; assist in cardiac catheterization and cardiac resuscitation; and assist in the post-operation monitoring, care, and treatment of heart-lung patients.

Dialysis Technology. An instructional program that prepares individuals to provide dialysis and intensive care to patients in a renal service, including cardiac monitoring, respiratory therapy, isolation procedures, and adjustment and maintenance of dialysis equipment.

Electrocardiograph Technology. An instructional program that prepares individuals to operate and maintain an electrocardiograph machine to record electromotive variations in the action of the patient's heart muscle. Includes instruction in making minor repairs.

Dental Laboratory Technology. An instructional program that prepares individuals to make and repair restorative appliances required for the oral health of the patient, as prescribed by a dentist.

Nuclear Medical Technology. An instructional program that prepares individuals to prepare and administer radioactive isotopes and to measure glandular and other bodily activity in therapeutic, diagnostic, and tracer studies, using a variety of equipment.

Electroencephalograph Technology. An instructional program that prepares individuals to operate and maintain the electroencephalograph to measure impulse frequencies and differences in electrical potential between the various areas of the brain to obtain data for the physician to use in diagnosing brain disorders. Includes instruction in making minor repairs.

Broadcast Technicians. Broadcast technicians operate and maintain the electronic equipment used to record and transmit radio and television programs. They work with microphones, sound and video tape recorders, light and sound effects, television cameras, transmitters, and other equipment.

In the control room of the radio or television broadcasting studio, these technicians operate equipment that regulates the signal strength, clarity, and range of sounds and colors in the material being recorded or broadcast. They also operate control panels that select the source of the materials being broadcast. Technicians may switch from one camera or studio to another, from film to live programming, or from network to local programs. By means of hand signals in television and by use of telephone headsets, they give technical directions to personnel in the studio.

When events outside the studio are to be broadcast, technicians go to the site and set up, test, and operate the remote equipment. After the broadcast, they dismantle the equipment and return it to the station.

As a rule, broadcast technicians in small stations perform a variety of duties. In large stations and at networks, on the other hand, technicians are more specialized, although specific job assignments may change from day to day.

Transmitter operators monitor and log outgoing signals and are responsible for operating the transmitter.

Maintenance technicians set up, adjust, service, and repair electronic broadcasting equipment.

Audio control engineers regulate sound pickup, transmission, and switching.

Video control engineers regulate the quality, brightness, and contrast of television pictures.

Recording engineers operate and maintain video and sound-recording equipment.

Field technicians set up and operate broadcasting equipment.

Some technicians operate equipment designed to produce special effects, such as the illusion of a bolt of lightning or the sound of police sirens, when programs originate outside the studio. The terms "operator," "engineer," and "technician" often are used interchangeably in describing the above jobs.

Supervisory personnel with job titles such as chief engineer or transmission engineer direct activities concerned with the operation and maintenance of studio broadcasting equipment.

Training, Other Qualifications, and Advancement

Federal law requires that anyone who operates broadcast transmitters in radio and television stations must have a restricted radiotelephone operator permit for which no examination is required. A person who works with microwave or other internal radio communications equipment, however, must have a general radiotelephone operator license, issued after the applicant passes a series of written examinations. These cover communications law and regulations, radio operating practices, and basic communications electronics.

Technical school, community college, or college training in engineering or electronics is the best way to prepare for a broadcast technician job, particularly for those who hope to advance to supervisory positions or to the more specialized jobs in large stations and in the networks. High school courses in algebra, trigonometry, physics, electronics, and other sciences also provide valuable background for a career in this occupation. Building electronic hobby kits and operating a "ham" or amateur radio also are good introductions to broadcasting technology. Some persons gain work experience as temporary employees while filling in for regular broadcast technicians who are on vacation.

Broadcast technicians must have an aptitude for working with electrical and mechanical systems and equipment. Manual dexterity - the ability to perform tasks requiring precise, coordinated hand movements - is necessary for success in this occupation.

Entry level workers are instructed and supervised by the chief engineer, or by other experienced technicians, concerning the work procedures of the station. They generally begin their careers in small stations, operating the transmitter and handling other technical duties after a brief instruction period. As they acquire more experience and skill, they are assigned to more responsible jobs. Those who demonstrate above-average ability may move into top-level technical positions such as supervisory technician or chief engineer. A college degree in engineering is becoming increasingly important for advancement to supervisory and executive positions.

Related Occupations

Broadcast technicians need the electronics training and hand coordination necessary to operate technical equipment; they generally complete specialized postsecondary programs, including courses in electronics and engineering. Others whose jobs have similar requirements include drafters, engineering and science technicians, surveyors, air traffic controllers, radiologic technologists, respiratory therapy workers, electrocardiograph technicians, electroencephalographic technicians, and medical laboratory technicians.

Technical Writers. An instructional program that describes the theory, methods, and skills needed for writing scientific, technical papers and monographs.

Technical writers put scientific and technical information into readily understandable language. They prepare manuals, catalogs, parts lists, and instructional materials used by sales representatives to sell machinery or scientific equipment and for use by technicians to install, maintain, and service equipment.

Technical writing requires a knowledge about specialized fields such as electronics, mechanics, chemistry, or one of the other sciences. Relatively few technical writers enter the occupation directly from school. The majority work initially in areas of less responsibility. Some begin as research assistants, editorial assistants, or trainees in a company's technical information department. In time, these people may assume writing duties and develop technical communications skills.

New and Emerging Technical Careers. Many of tomorrow's jobs are here today. We call them emerging careers: occupations demanding new knowledge and new skills, and offering new and exciting opportunities for those who are ready for them.

New careers are emerging so rapidly, and in some cases, changing so continuously, that it is not possible to present for each new field standardized information on its advantages and disadvantages, education or training needed, working conditions, numbers of workers, typical earnings, or where the job will be located.

Robot Technicians

The robotics industry gives every indication of taking off and moving ahead as fast as the computer industry did a few years ago. Business analysts predict an annual growth rate of over 30 percent through the rest of this decade. Forecasters predict robot sales will range from $214 to $500 million a year for the next five years.

If the robot industry is to continue its projected growth, it must have an adequate supply of robot technicians and engineers.

The frontiers for robots and microprocessor (minicomputer) industries have moved beyond creating mechanical workers to creating machines that think. This artificial intelligence is attempting to duplicate some of the brain's function with machines.

Changes in the manner in which goods are produced and services are provided also affect occupational and industrial employment. For example, as an industry automates production (installs robots), the mix of workers is likely to change, which in turn will have different effects on an occupation's employment growth.

Technological change is expected to affect employment in many industries and occupations through the mid-1990's. The increasing use of robots in automobile manufacturing, for example, is one factor expected to limit employment growth in that industry. The increasing use of word-processing equipment will limit growth of employment of typists. Despite widespread technological advances, however, employment should continue to increase in most industries and occupations during the 1980's and early 1990's.

The continued growth in the importance of technology to national defense, office work, manufacturing, and other activities is expected to cause much faster than average employment growth for technologists and technicians such as legal assistants, programmers, and electrical and electronics technicians. The employment opportunities for technologists and technicians should increase 30 to 49 percent between 1982 and 1995.

APPENDIX D 5
Private Agencies

Martin-Marietta Aerospace Corp.
Michoud Blvd.
New Orleans, Louisiana
Gulf States Utilities Co.

Louisiana Power and Light
Waterford 3 Power Plant
Taft, Louisiana

Gulf States
5554 Essen Lane
446 North Boulevard (Main Office)
Baton Rouge, Louisiana

Estes Industries
Penrose, CO 81240
Rockets, technical manuals

APPENDIX D 6

Journals

Industrial Education
262 Mason Street
Greenwich, Connecticut 06830

School Shop
Box 8623
Ann Arbor, MI 48107

Science 87
P. O. Box 10790
Des Moines, IA 50340

APPENDIX E

Principles of Technology: Equipment List

PRINCIPLES OF TECHNOLOGY: EQUIPMENT LIST

The following equipment list consists of three major sections. These sections are numbered below:

1. "Equipment List for Principles of Technology"
   This section contains the equipment for the hands-on labs. It has 13 pages of information arranged in five columns. The first column to the left gives the item number. The second column gives the item name. The third column gives the number of items needed per set-up. Column four gives the desired specifications and a description of the item. The last column indicates that the item is of special design and therefore has a special design sheet in the third major section of this document.

2. "Principles of Technology: Demonstration Equipment"
   This section contains the equipment needed for the teacher demonstrations. It consists of 5 pages. Each page is divided into six columns. These columns identify respectively: demonstration number, number of items needed, item name, description, item number that correlates with the same item noted in the lab equipment list, and a designator that indicates the item is of special design.

3. "Design Notes on Special Equipment"
   This section contains special design notes for special laboratory equipment. It consists of 71 pages. These pages contain information on the special items of equipment needed for the 90 hands-on labs. Rough drawings of the devices, parts lists, and source references are found in this section. (Special design items needed in the teacher demonstrations are found in the teacher's guide.)

EQUIPMENT COSTS

Based upon prices from 1984-85 catalogs, the cost for all equipment needed to conduct all 90 hands-on labs and all 49 teacher demonstrations is:

$8,700 to $9,300 per set-up.

EXAMPLE:

For a class of 20 (two students per lab station) or a class of 30 (three students per lab station), ten lab stations would be needed. If two experiments are run concurrently during each lab period, only five sets of equipment will be needed. Total cost for five sets of equipment (10 stations per lab) will be:

$43,500 to $46,500.

EQUIPMENT SOURCES

Throughout the pilot phase in the development of Principles of Technology (PT), there have been three principal equipment suppliers who have served the project nationwide. These suppliers are:

Company	Contact Person
Brodhead-Garrett Company 4560 East 71st Street Cleveland, OH 44105	Mr. George Bamberger, VP of Sales (216) 341-0248
Sargent-Welch Scientific Co. 7300 North Linder Avenue P.O. Box 1026 Skokie, IL 60077	Mr. Bob Bieser, VP of Sales (312) 677-0600
Scientific Labs, Inc. P.O. Box 803788 Houston, TX 77280-3788	Mr. Tim Brown, President (713) 464-6068

Other suppliers who were consulted in the preparation of the Principles of Technology equipment list are:

Company	Address
Allied Electronics*	401 E. 8th Street - Fort Worth, TX 76102
Cambion Division of Midland Ross Corp.	One Alewife Place - Cambridge, MA 02140
Central Scientific Co.	11222 Melrose Ave. - Franklin Park, IL 60131-1364
Dwyer Instruments	P.O. Box 373 - Michigan City, IN 46360
Edmund Scientific	101 East Gloucester Pike - Barrington, NJ 08007
Energy Concepts, Inc.	3254 North Kilbourn - Chicago, IL 60641
Hampden Eng. Corp.	P.O. Box 563 - East Longmeadow, MA 01028
Inotek	11212 Indian Trail - Dallas, TX 75229-3585
Knight Electronics	10730 Colewood Lane - Dallas, TX 75243
J.A. Noll Co.	Box 312 - Monroeville, PA 15146
Measurements Group, Inc.	P.O. Box 27777 - Raleigh, NC 27611
Meredith Instruments	6517 West Eva - Glendale, AZ 85302

Northern Hydraulics, Inc.	P.O. Box 1499 - Burnsville, MN 55337
Omega Engineering, Inc.	P.O. Box 4047 - Stamford, CT 06907-0047
PCB Piezotronics, Inc.	3425 Walden Ave. - Depew, NY 14043-2495
Radio Shack*	500 One Tandy Center - Fort Worth, TX 76102
Stock Drive Products	55 South Denton Ave. - New Hyde Park, NY 11040
Trans-Tek, Inc.	Route 83, P.O. Box 338 - Ellington, CT 06029
U.S. Plastics, Inc.	
W.W. Grainger, Inc.*	1520 Round Table Drive - Dallas, TX 75247

These suppliers may be able to help you obtain certain equipment items.

* These companies have many stores or warehouses throughout the nation.

COA T
Ross
7/21

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
1	H.D. SUPPORT STAND	1	Self-supporting 6' tall x 36" wide	*
2	Force Beam		Solid wood 40"l x 6"w x 3"t with six eyebolts	
3	SPRING BALANCE	3	Large capacity 0 to 25 lb	
4	CONTAINER	1	One-gallon capacity for liquids or fine powders	
5	CHAIN	2	40-lb test, 18" length	
5.1	CORD	3	30-lb test, 24" length	
6	KEY CHAIN RING	1	One-inch diameter, steel	
7-8	BASIC MEASUREMENT SET	1		
7.1	Straightedge/ruler		One plastic or wood	
7.2	Protractor		One plastic	
8.1	Caliper, vernier		One plastic or metal	
8.2	Caliper, bow		One plastic or wood	
42	Meter stick		One wood w/brass tip, Eng/SI	
9	SPRING HOLDER JIG	1	Wood frame support w/rod drilled at one end for spring	*
9.1	Coil Spring		One coiled spring such as from clutch or brake-pedal return in car or light truck	
	CLAMP SET			
13	C-type		One deep, two regular throat	
63	Tubing type		Four polycarbonate, stepped	
	Tubing connector		Six aircraft type	
34	Thermometer type		Two hook-n-collar types	
	WEIGHT SET	1		
12	Slotted, 1g cap		One set consisting of 1-5 kg, 1-2 kg, 2-1 kg, and 1-0.5 kg	
11	Weight hanger		One w/long hook of 1-kg wt	
40	Slotted, sm. cap.		One set w/1-500 gm, 5-100 gm; 1 ea 50 gm, 10 gm, 5 gm, 1 gm; 2 ea 20 gm, 2 gm; w/storage rack	
41	Weight hanger		One 50 gm hanger	
14	HYDROMETER, SCALED	1	Range 1.1 to 1.3 on scale	
15	HYDROMETER	1	Pocket type using floating colored balls	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
	BEAKER SET	1		
16	Small		Four 600 ml graduated type	
	Large		Two 1000 ml graduated type	
17	MANOMETER	1	U-tube, water/Hg type; 1-m long; w/traps; polycarbonate	
17.1	Dye		One 4 oz bottle for water	
17.2	Mercury		One 500 gm bottle	
18	PUMP	1	Vacuum/pressure type, manual	
20	AIR CHAMBER ASSEMBLY	1		
	Tubing barbs		Two, 1/2" thread to 1/4" nipple, PVC or nylon	
22	Accumulator		One made of PVC w/pipe cap	
19	TUBING SET	1		
19.1	Small diam		Two, 4-ft lengths 1/4" x 1/16" tygon or plastic	
19.2	Large diam		Two, 4-ft lengths 1/2" (or 3/4") x 1/4" tygon or plastic	
19.3	Bubble type		One, 3-ft section tygon	
	TUBING ADAPTER SET	1		
	Small to medium		Two, 1/4" to 1/2" diam	
	Small to large		Two, 1/4" to 3/4" diam	
	Medium to large		Two, 1/2" to 3/4" diam	
	PVC adapters		Two, 1/2" to 1/4" NPT	
21	PRESSURE GAGE	1	Compound type, 0-30 psi and 0-30" Hg w/ 1/4" NPT	
23	MULTIMETER, ANALOG	1	Such as a Simpson 260 or a Triplett 310	
27	MULTIMETER, DIGITAL	1	3 1/2 digit w/full DC and AC functions; 10-Megohm input Z and must read 0.1 microamp & 0.1 mV	
	BATTERY SET	1		
25	Dry cell		Two, 6-volt lantern type	
25.1	Transistor		One, 9-volt transistor type	
26	Wet cell		One auto type PER LAB.	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
	ELECTRICAL WIRE SET	1		
24	Universal leads		One set, 14 to 16 AWG w/ ends and probes	
84	Wire segments		One set of 18 to 24 AWG wire w/different lengths, ends stripped and tinned	
111	Magnet wire		One 1-lb spool 30 AWG coated	
	SWITCH SET	1		
28	SPST, knife		Two, 4 A @ 120 V	
53	SPST, push button		One, NO-type, 4 A @ 120 V	
69	DPDT, knife		One, 4 A @ 120 V	
30	LAMP, MINIATURE	2	Type 40, miniature screw base	
29	LAMP BASE	2	For miniature lamps	
	THERMOMETER SET	1		
31	l.i.g. scaled		Two, dual scale -10 to +110 C	
32	l.i.g. blank		Two, equal ranged w/item 31	
33A	HOT PLATE	1	750 watt rating, 80 cm square	
33B	GAS BURNER	1	Optional, Bunsen or Fisher; match to fuel gas available	
35	SUPPORT STAND SET	1		
35.1	Base		Two for 13-mm threaded rods	
35.2	Clamp base		One for 13-mm rods	
35.3	Threaded rods		One each 1/2" (13-mm) diam by 36" long and 24" long	
35.4	90-deg clamp		Two for 13-mm rods	
35.5	Adj. clamp		One for 13-mm rods	
35.6	Unthreaded rods		Four 13-mm diam x 24" long	
35.7	Ring clamp		One needed if item 27 B used	
36	THERMOCOUPLE	1 set	Type-E, Chromel-constantan 24 AWG wire 30" long w/plugs	
	CUP, STYROFOAM	3	16 to 24 ounce size	
37	PULLEY SET	1		
37.1	Single		Three single sheave type	
37.2	Double		Two double sheave, abreast or tandem arrangement	
37.3	Triple		Two triple sheave, abreast or tandem arrangement	
37.4	Stepped		One, w/three different diam	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
43	WINCH ASSEMBLY	1		*
	Disk		One, wood or metal w/10" diam and 0.5" thick grooved rim	
	Mount		One, wood board, 14" x 10" x (1/2" to 5/8")	
	Winch		One, 1/2 ton cap manual	
	Pulley		One, grooved 1" diam mounted	
38	SPRING BALANCE SET	1	Dual scale type (SI/English)	
	Small		Range 0 to 2.5 N (0.5 lb)	
	Medium		Range 0 to 5 N (1.0 lb)	
	Large		Range 0 to 20 N (4.5 lb)	
30	MONOFILAMENT LINE	1	One roll, 25 yd of 10 lb test	
	PNEUMATIC CYL. SET	1	Double-acting types	
44	Large		One, w/6" stroke & 1.125 diam	
107	Small		One, w/4" stroke & 3/4" diam	
	Barbs		Four, nylon or brass threaded tubing barbs for 1/4" id tubing	
45	WEIGHT STAGE	1	Aluminum disk attached to item nos. 44 or 107	*
46	WATER PUMP SET	1		
	Motor		One, DC powered rated at 12 V DC @ 10 A (or less).	
	Pump		One, w/rated pumping capacity of 300 gph (or greater)	
47	POWER SUPPLY	1	Output 0 to 20 V DC @ 10 A w/ front panel V & I meters, AC output optional	
50	CONTAINER, LG FLUID	1	5-gal plastic w/lid	
52	ELECTRIC MOTOR ASSEMBLY	1		*
	Motor		Permanent magnet type, rated at 12V DC @ 6 to 10 A	
	Mount		Wood construction, adjustable	
	Accessories		1 ea drive pulley, drum, & shaft coupler	
51	STOPWATCH	1	Digital readout to 0.1 sec, w/2 functions (reg. & lap)	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
54	SOLENOID ASSEMBLY Solenoid Mount	1	 One, 12 V DC type w/1" pull One, wood construction w/ three 5-way binding posts	*
55	CONVEYOR ASSEMBLY	1	Wood construction	*
56	BALANCE, TRIPLE-BEAM	1 needed per 3 stations	Similar to OHAUS model 2610	
57	STROBOSCOPE	1	Adjustable flash rate 180 fpm to 10,000 fpm	
58	WATER CHANNEL ASSEMBLY	1	Vinyl or metal rain gutter w/ V-notched obstruction (weir)	*
59	AIR STORAGE TANK	1	Six gal w/pressure gage, brass manifold, shutoff valve, and 6-ft hose w/a quick-connect-disconnect female coupler	
60	PRESSURE REGULATOR	1	0-30 psi w/quick-connect male connector on input and brass output barb for 1/4" id tubing	
	GAS ORIFICE ASSEMBLY	1		*
62	Orifice body		One machined acrylic w/4 barbs (for 1/4" id tubing)	
61	Collection column		One, Plexiglass or acrylic tube w/2" id & 13"-24" long	
61.1	Water bath		One, tray 4"-5"d x 6" x 9"l	
65	OSCILLOSCOPE Probes	1	Dual channel, 0 to 10 MHz Two, X1/X10 type w/clip	
66	FUNCTION GENERATOR	1	0 to 10 MHz, 10 V (p-to-p) output into 600-ohms w/3 wave-forms (sine, square, sawtooth)	
67A	DEWAR FLASK	1	1.9 l. capacity w/12 cm id	
67B	INSULATED CONTAINER	1	3 lb coffee can wrapped w/2" styrofoam insulation	

Last column (*) indicates design sheets.

CORD/PT
Ross
3/01/86

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
	HEAT TRANSFER ASSEMBLY SET	1		*
68A	Conductor tester		One insul board w/Al slug	
68B	Insulation tester		Two Al plates	
64	Lamp socket		One porcelain, standard	
64.1	Heater		One light bulb, 100 W	
70	CONTAINER SET	1	For fluids, made of metal	
	Small		Three, 1 lb coffee can	
	Large		Two, 3 lb coffee can	
	FRICTION PLATE ASSEMBLY	1		*
71	Fixed		One Al, 6" x 18" x 3/16"	
72	Movable		One Al, 4" x 6" x 1/4" w/all edges smoothed & rounded	
	AIR-FLOW ASSEMBLY	1		*
73	Tube		Plexiglass or acrylic 24" x 2" id w/flow-control holes	
74	Objects		Three different shapes w/ cross-sectional area 70-80% of air-flow tube	
75	AIR-FLOW SYSTEM	1		
75.1	Vacuum		One 5-gal, 1.1 hp dry type	
75.2	Hose		One, 6-ft x 2.5" wire reinforced plastic type	
75.3	Adapter		One, 2.5" down to 2" id	
76	Duct tape		One 20-yd roll canvas adhesive, 2.5" to 3" wide	
78	GARDEN HOSE SET	1		
78.1	Large		One 25' length of 5/8" to 3/4" diam w/male & female conn	
78.2	Small		Two 25' lengths of 3/8" to 1/2" diam w/male & female conn	
97	PRESSURE GAGE TAP	2	PVC threaded tee, w/outputs male/female/male, 3/4 diam	
	Gage adapter		One male 3/4" thread to 1/4" female NPT	
	Teflon tape		One roll teflon pipe seal	
	PLATFORM SCALE	1	Household "bathroom" type	
	FLOW RESTRICTOR SET	1	Each to be 4" X 4" size	*

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
79	Plates		Seven metal w/different sizes of flow holes	
80	Filters		Two sections, fiber type	
opt.	MANOMETER, SLANT TUBE	1	Slant tube w/0" to 3" water range. Option: use U-tube	
81	SOLDERLESS BREADBOARD	1	Plastic, 6.5" x 2.25" w/128 terminals and 5 tie points/term	
82	RESISTORS SET Fixed assortment	1	1/2 watt, 5% tolerance of: 1-10 ohm, 2-100 ohm, 2-560 ohm, 1-1 kohm, 2-1.5 kohm, 2-2.5 kohm 1-50 kohm, 1-1 Mohm, & 4-10 Mohm	
82.1	Power type		One each 10 watt 50 & 100 ohm	
83	Variable		Two each, 2 watt 30% tol. 0-10 kohm & 0-100 kohm. Make 1 audio taper & other linear	
85	THERMAL PIPE ASSEMBLY	1	Two copper pipe sections, 1 insulated and 1 uninsulated	*
85.1	Stoppers		Three rubber stoppers per tube w/one being a 1-hole type	
86	Funnel		One plastic type	
87	SPRING TEST ASSEMBLY	1	Wood construction w/ spring Option of two designs.	*
91	HYDRAULIC FLOW & SHOCK ASSEMBLY	1	PVC construction 1/2" to 3/4" pipe w/tee's & flexible tube section	*
77	Valves		One each ball & gate, PVC	
89	AIR MOTOR	1	Rated at 1/20 hp min w/ 1/4" input air lines and a 3/8" diam output shaft	
89.1	Gage accessory		One PVC 1/2" diam tee w/3 female ends and 2 tubing barb adapters for 1/4" id tubing	
90	Stirring attachment		One, w/sleeve coupler	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
88	FLYWHEEL ASSEMBLY	1	Wood construction w/cast iron wheel 8"-10" diam of 3-6 lb of weight mounted on 1/2" diam shaft w/roller bearing support	*
88.1	Drive belt		One, flat belt (from sewing machine or carpet sweeper)	
88.2	Friction brake		One leather strap attached	
92	STRIP-CHART RECORDER	1 for class	Servo type w/4" wide chart and 1 Mohm input Z. Variable ranges and speeds	
93	ROTAMETER	1	Air-flow meter w/range of 180-1800 SCFH (cu ft/hr)	
94	SPECIFIC HEAT SAMPLE SET	1	3-metal cyl. each of same mass but different volume	
95	Tongs		One set w/insulated handles	
98	WATT-HOUR METER ASSEMBLY	2 per class		*
98.1	Watt-hour meter		One domestic type	
98.2	Line volt monitor		One panel voltmeter w/range of 10% to either side of AC line	
98.3	Circuit breaker		One 30 A rated w/switch	
98.4	Mult outlet strip		One w/5 or 6 outlets	
99	MOTOR-GENERATOR SET	1	Two identical assemblies w/ fixed and rotating coils whose configuration can be set via external connections	
100	WINCH,"COME-A-LONG"	1	1 ton to 1 1/2 ton capacity	
101	PIPE CLAMP ASSEMBLY	1	3-ft long w/disk replacing handle	*
	GEAR SET	1		
102	Spur type		A collection of 5 or 6 spur gears w/shafts and frame to be mounted on as per lab 7M3	
103	Worm type		One worm screw driving a wheel gear	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
104	BELT DRIVE ASSEMBLY	1	Wood construction w/2 stepped drive pulleys at adj distances	*
104.1	Belt		One V-belt for stepped pulley	
104.2	Drive belt		One timing belt w/3mm pitch 300 mm length, 9 mm wide	
104.3	Drive pulleys		Double flange w/1-8.3 cm diam & 1-14 cm diam or greater	
105	HYDRAULIC JACK	1	1 1/2 ton cap w/high pressure gage, 0 to 5000 psi	*
106	PRESSURE STAGE	1	Steel construction w/springs	*
108	TRANSFORMER ASSEMBLY	1	Soft steel construction	*
108.1	Coil forms		Four plastic or cardboard tubes, just large enough to fit over bolts in assembly	
110	TRANSFORMER	1	One step-down center tapped w/115 V AC primary & 12.5 V AC @ 1 A secondary	

END OF FIRST YEAR EQUIPMENT REQUIREMENTS

200	IMPULSE MEASUREMENT ASSEMBLY	1	Consists of frame, impact plate, spring, rod, and guide	*
201	MOMENT OF INERTIA ASSEMBLY	1	Rotating rod w/movable weights	*
202	FLUID MOMENTUM ASSEMBLY	1	Two flexible hose sections w/90-degree PVC elbow	*
205	TORSION PENDULUM ASSEMBLY	1	4-ft long steel rod w/cross arm assembly & movable weights	*
206	MECHANICAL SHOCK ASSEMBLY	1	Wood construction	*
207	VIBRATION TRANSDUCERS	2	Piezoelectric w/frequency range of 1 Hz to 5 kHz & sens of 10 mV/g, linearity 1%, and excit of 18-28 V DC @ 2-20 mA	
208	Battery		One per transducer, such as Burgess type K15	
207.1	BNC cables		Two 4-ft long w/connectors at both ends minimum	

Last column (*) indicates design sheets.

CORD/PT
Ross
3/01/86

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
209	SPEAKER	1	3" wide freq range speaker w/1000-ohm CT transformer	
210	MICROPHONE	1	Omnidirectional 30 Hz to 15 kHz range w/4-10 V DC pwr	
211	RESONANCE TUBE	1	2" id x 2' long	
213	CAPACITORS	1		
213.1	Small set		Three 47 pF nonelectrolytic	
213.2	Large set		One 10 mmF electrolytic	
219	REFLECTOR	1	Parabolic, 18" diam metal	
218	PHOTOMETER	1	Laser power meter type w/ range 0.003 mW to 10.0 mW	
217	FLOOD LAMP ASSEMBLY	1	Fixture w/reflector and lamp rated at 300 W	
214	WIND GENERATOR ASSEMBLY	1		*
	Duct fan		1-10" diam w/300 cfm min flow	
	Flow tube		7'-8' length w/10" to 8" diam	
	Output fan		One, 7" diam w/5 blades	
	Output assembly		With 1.5 V DC motor, shaft, & cradle to hold items aligned	
215	ANEMOMETER	1	Slant-tube manometer calibrated in wind speed	
216	SOLAR CELL PANEL	2	Each rated 6 V DC @ 50 mA	
225	FLUORESCENT FIXTURE	1	8 W to 15 W miniature can be battery powered	
227	WATTMETER, AC	1	1000 W range, or optional design of POWER MEAS MODULE	*
226	STEAM ENGINE	1	Electrically heated w/output flywheel	
234	BIMETALLIC STRIP ASSEMBLY	1	Linear strip w/ electrical contacts, adjustable	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
221	THERMOELECTRIC MODULE ASSEMBLY	1	Two Al blocks drilled for temp chambers; insulated by styrofoam blocks; sandwiching a thermoelectric module	*
228	LOAD CELL ASSEMBLY Strain gage Output board Load member Connecting cable	1	 Two unbonded foil type One PC board w/bridge circuit One PVC 2" slip-type coupler One 3-ft long 4-conductor wire	*
231	PRESSURE MANIFOLD ASSEMBLY	1	Wood and PVC construction	*
232	D/P CELL	1	One electrical output w/0 to 15 psi range	
233	LIQUID FLOW ORIFICE ASSEMBLY	1	PVC construction w/inserts	*
229	LVDT Accessory set	1	DC-to-DC type w/1" range One set as per lab 11E2	
237	SOLID-STATE TEMPERATURE SENSOR	1	Probe w/temp to mV con-vertor and battery. Reads 1 mV/degree C, at ice pt=0 mV out	
236	PRT(Platinum Resis-tance Thermometer)	1	Probe w/100-ohm nominal resistance	
235	THERMISTER	1	Probe 3" long x 0.095" diam w/ nominal resistance of 2252 ohms at 25 degrees C	
238	SPECTROSCOPE	1	Student type, hand-held w/ diffraction grating and built-in wavelength scale	
223	HV POWER SUPPLY	1	Spectrum tube power supply w/spectrum tube holder	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME -	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
224	SPECTRUM TUBE SET	1		
224.1	Hydrogen		One	
224.2	Helium		One	
224.3	Nitrogen		One	
224.4	Neon		One	
224.5	Mercury vapor		One	
222	LASER	1	Helium-Neon w/output power of 0.48 to 0.7 mW.	
239	RADIATION APPARATUS SET	1	Two or three cans of the same volume and material but with different external surface colors; blk, silver, & white	
240	LAZY SUSAN OPTICS TABLE	1		*
	Bearing		One 3" diam "lazy susan" type	
	Base		One wood, 1' x 1' x 5/8"	
	Disk		One heavy poster board, 17.5" diam w/white matte finish	
242	LENS SET	1	NOTE: FL MEANS FOCAL LENGTH	
	Positive long FL		One, plano-convex lens 33-mm diam w/233-mm FL	
	Positive short FL		One, plano-convex lens 32-mm diam w/58-mm FL	
	Negative		One, plano-concave lens 35-mm diam w/-53 mm FL	
	Cylindrical		One, glass rod 2"-3" long x 3 to 4 mm diam	
	FILTER SET	1		
241	Color set		One set of 8 mounted 2" x 2" solid color slides	
246	Polorized		Two, mounted 2" x 2" filters	
	Neutral density		One, 1/2" x 1" x 1/4" w/ optical density of 0.5 at 500 nm nominal transmittance = 32%	
242.1	MIRROR SET	1	Flat, front-surface type	
	Lg flat		One 22mm x 22 mm x 5 mm	
	Sm flat		One 8.2 mm diam x 1.5 mm	

Last column (*) indicates design sheets.

EQUIPMENT LIST FOR PRINCIPLES OF TECHNOLOGY

ITEM NO.	ITEM NAME	NUMBER per LAB STATION	SPECIFICATIONS AND DESCRIPTONS	see be-low
242.2	BEAM SPLITTER SET Mirror type Glass type	1	 One 25 mm x 38 mm x 3mm w/ 50% transmission & 50% reflect One microscope slide	
242.3	PRISM SET Right Angle (PORO) Equilateral Dove Wedge	1	 One 19 mm x 19 mm x 25 mm, unaluminized One, 25 mm x 25 mm size One, 76 mm x 25 mm x 18 mm One, 40 mm x 55 mm w/10% critical angle	
244	DIFFRACTION GRATING	1	One, 2" x 2" mounted w/ 13,400 grooves/inch	
243	SCREEN	1	One ground glass screen, 89 mm x 127 mm x 3.4 mm	
250	FIBER OPTICS SET Cable	1	 One 5-m length of fiber optics cable	
251	LED/photo diode Couplers		One pair of LED and photo diode detectors, IR type One each, input and output	

PRINCIPLES OF TECHNOLGY: DEMONSTRATION EQUIPMENT

DEMO NO.	NUMBER of ITEMS NEEDED	ITEM NAME		ITEM NO. in EQUIP. LIST	Special
1DM	1	Sponge			
	1	Meter stick		42	
	2	Spring balance scale	Dual scale type w/5-lb range	38	
	2	Suction cups	Rubber, 2"-3" diam		
	2	Cord	12"-18" length, 40-lb test	5	
	1	Paint can	Gallon size filled w/sand		
	1	SOCKET FIXTURE			*
	2	C-clamps		13	
	1	Torque wrench			
	2	Connector clamp	Aircraft type w/1.25" max expanded od for hose		
	1	Masking tape	One roll, 5/8" wide		
1DF	1	Flow indicator			
	2	Fluid containers	5-gal cap, 1 w/outlet at bottom and 1 w/o outlet		
	2	Tubing sections	Tygon bubble type, 2 ft	19	
	2 to 4	Connector clamp	Aircraft type w/0.7" max expanded od for tubing		
	1	Tubing clamp	Polycarbonate pinch-off	63	
	1	Lab jack	Heavy-duty type		
	2	Beakers	One liter cap Pyrex		
	1	Stopwatch		51	
1DE	2	Batteries	Lantern type, 1.5 volt		
	2	VOM	Analog volt-ohm-milliammeter	23	
	3	Hook-up wire	18-24 AWG wire segments 4" & 6" long, 1-red, 1-black, & 1-yellow insulation		
	2	Alligator clip	Miniature type		
	1	SPST switch	Knife type	28	
1DT	1	CONDUCTION BAR	14" x 1" x 1/2" w/5 holes made of copper		*
	1	Hot plate	750 watt, 80 cm square	33A	
	1	Lab jack	Heavy-duty type		
	5	Nails	"16-penny"		
	1	Paraffin	Two ounce amount		
	1	Thermo crayon			
	1	INSULATOR SHIELD			*
2DM	1	Basketball			
	1	Spring balance scale	Dual scale type w/5-lb range	38	
	1	Block, wood or brick			

PRINCIPLES OF TECHNOLGY: DEMONSTRATION EQUIPMENT

DEMO NO.	NUMBER of ITEMS NEEDED	ITEM NAME		ITEM NO. in EQUIP. LIST	Special
	1	Meter stick		42	
	1	Cord	1-ft length, 40-lb test	5	
2DF	2	Fluid container	5-gal cap (bucket)	50	
	1	Water pump	Electric motor driven	46	
	1	Power supply	AC/DC type	47	
	2	Hoses	For connection to pump	19	
2DE	1	Slotted weight set	Small cap	40	
	2	C-clamps		13	
	2	VOM	Analog volt-ohm-milliammeter	23	
	1	Support stand		35	
	1	Pulley	For support stand	37	
	1	Power supply	AC/DC type	47	
	1	DC motor		52	
	1	Stopwatch		51	
3DM	1	Toy car	Windup or electric type		
	1	Stroboscope		57	
	1	Stopwatch		51	
	1	Meter stick		42	
	1	DC Motor		52	
	1	6" diam disk	For connection to motor		
	1	Power supply	AC/DC type	47	
	1	C-clamp		13	
	1	Masking tape	One roll, 5/8" wide		
3DF	1	Fluid container	5-gal cap, 1 w/outlet at bottom		
	1	Fluid container	5-gal cap (bucket)	50	
	1	Triple-beam balance		56	
	2	Beakers, large	1-liter size		
	1	Stopwatch		51	
	1	Tubing clamp	Polycarbonate pinch-off	63	
3DE	2	Batteries	Lantern-type, 6 volt	25	
	1	Lamp w/base	6-volt		
	1	SPST switch	Knife type	28	
	1	VOM	Analog volt-ohm-milliammeter	23	
	1	Oscilloscope		65	
	1	Function generator		66	
3DT	3	CONDUCTION BAR	14" x 1" x 1/2" w/5 holes		*
	1		made of steel, 2 of copper		
	2	Hot plates	700 watt		
	2	Lab jacks	Heavy-duty type		

PRINCIPLES OF TECHNOLGY: DEMONSTRATION EQUIPMENT

DEMO NO.	NUMBER of ITEMS NEEDED	ITEM NAME		ITEM NO. in EQUIP. LIST	Special
	8	Nails	"16-penny"		
	2	Paraffin	Two ounce amount		
	2	Stopwatches		51	
4DM	1	Plate	Al or steel, 18" x 6" x 1/4"		
	2	Weights	1-lb lead bricks		
	1	Oil	1 oz of lubricating oil		
	2	Cup-hook screws			
	1	Spring balance scale	Dual scale type w/5-lb range	34	
4DF	1	FLOW SHROUD	w/mylar ribbon strips		*
	1	Auto air-filter			
	1	Vacuum			
	1	Manometer	Slant-tube type		
	1	Confetti	Approximately 1 cup measure		
4DE	1	DEMONSTRATION BOARD	Board mounted w/4 different wires, each w/ diff resistance		*
	1	Power supply	AC/DC type	47	
	2	DMM	Digital multimeters	27	
4DT	1	CHIMNEY ASSEMBLY	Uses Cu pipe, insulation, & aluminum foil		*
	1	Support stand		35	
	1	Bunsen/Fisher burner	Butane torch optional		
	1	Temp indicator strip	Reversible type		
	1	Thermo crayon set	70 to 100 degree C range		
5DM	1	Plexiglass tube	2-ft long x 2" id	73	
	1	Weight hanger	50-gm for slotted weight set	41	
	1	Slotted weight set	Small capacity set	40	
	3	Nails	Roofing type		
	1	Styrofoam board	2" x 4" x 14", dense type		
	1	Cord	18" length, 40-lb test	5	
	1	Masking tape	One roll, 5/8" wide		
5DF	1	Air tank	6-gal size	59	
	1	Pressure regulator	0 to 30 psi	60	
	1	Air motor	Fractional horsepower type	89	
	1	DC motor	Permanent magnet type	52	
	1	Miniature lamp w/base	1.5 volt bulb		
	1	Support stand		35	
5DE	1	SPST switch	Knife type	28	
	1	Battery	6-V dry cell	25	

PRINCIPLES OF TECHNOLGY: DEMONSTRATION EQUIPMENT

DEMO NO.	NUMBER of ITEMS NEEDED	ITEM NAME		ITEM NO. in EQUIP. LIST	Special
	1	Resistor, variable	0 to 20 ohms		
	1	Resistor, fixed		82	
	1	Capacitor	Nonelectrolytic, w/value of 5-10 microfarads		
	1	Power supply	AC/DC type	47	
	1	Strip-chart recorder	Servo type	92	
	1	ADJ VOLT-DIVIDER CKT	As described in Demo 5DE		*
5DT	1	PIPE ASSEMBLY	As described in Demo 5DT		*
	1	Power supply	AC/DC type	47	
	1	Strip-chart recorder	Servo type	92	
	1	Pump	Electric motor driven	46	
	1	Thermocouple	Type E w/ice pt ref junction	36	
	1	Fluid container	5-gal cap (bucket)	50	
6DM	1	H.D. support stand		1	
	1	Slotted weight set	Large capacity	12	
	1	Weight hanger	1-kg size	11	
	1	Cord	8-ft, 60-lb test		
	1	Pulley		37	
	1	Meter Stick		42	
	1	Masking tape			
	1	Stopwatch		51	
6DF	1	H.D. support stand		1	
	1	Slotted weight set	Small capacity	40	
	1	Weight hanger	50-gm size	41	
	1	Cord	8-ft, 60-lb test		
	1	Pulley		37	
	1	Air tank	6-gal size	59	
	1	Pressure regulator	0 to 30 psi	60	
	1	Air motor	Fractional horsepower type	89	
	1	Rotameter			
	1	Masking tape			
	1	Stopwatch		51	
6DE	1	Power supply	AC/DC type	47	
	1	Miniature lamp w/base	6-volt bulb	29 & 30	
	1	SPST switch	Knife type	28	
	1	VOM or voltmeter		23	
	1	DMM or ammeter		27	
	1	Transparency	Of a kilowatt-hour meter		
	1	Resistor, variable	0 to 20 ohms		
7DML		VARIOUS COMMON DEVICES THAT INCORPORATE LEVERS			

PRINCIPLES OF TECHNOLGY: DEMONSTRATION EQUIPMENT

DEMO NO.	NUMBER of ITEMS NEEDED	ITEM NAME		ITEM NO. in EQUIP. LIST	Special
7DMR	1	Power supply	AC/DC type	47	
	1	DC motor	Permanent magnet type	52	
	1	Drive pulley	1.25" diam		
	1	Stroboscope		46	
	1	Multi-step pulley		37.4	
	3	Rubber bands	Broad heavy-duty type, short		
	1	Support stand		35	
7DF	1	Hydraulic jack		105	
7DE	1	Transformer	25-V ct step-down type		
	1	Autotransformer			
	4	DMMs		27	
	1	Resistor	Power type 50 ohm, 30 watt		
	1	"Pigtail" power cord			

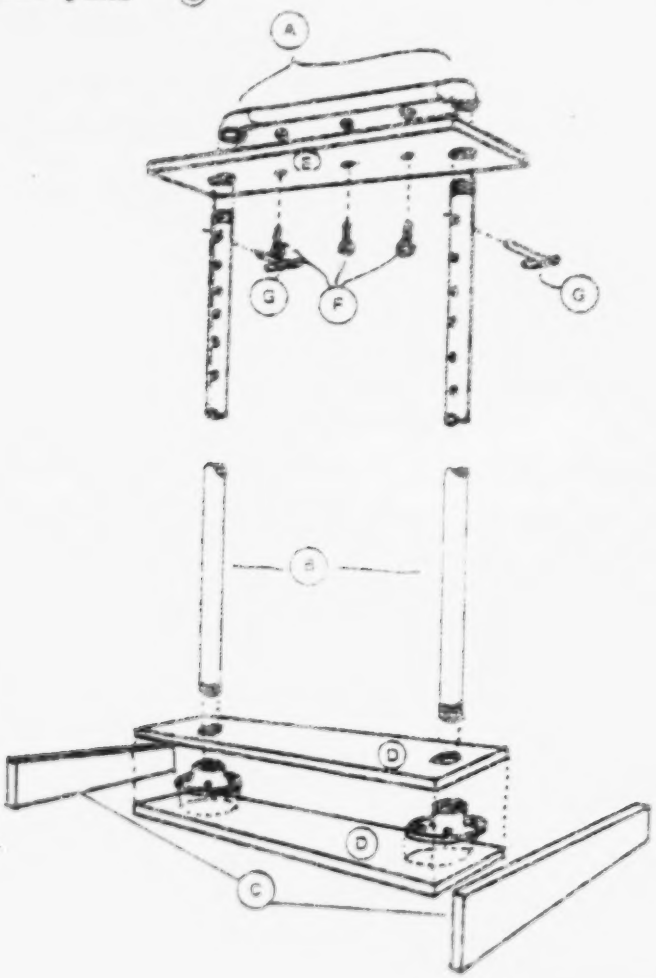
END OF FIRST YEAR DEMONSTRATIONS

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Heavy-Duty Support Stand Item No. 1

MATERIALS

2 - 90 degree elbows with 34 1/2" length of 5/8" to 3/4" diam pipe between (A)
2 - 6 ft long iron or steel pipes (5/8" to 3/4" diam) (B)
2 - 1/2" t x 3" w x 24" long boards (C)
2 - 5/8" t x 4" w x 36" long boards (D)
1 - 1" t x 4" w x 36" long board (item No. 1.1) (E)
3 - Eye bolts (F)
2 - Adjustment pins (G)

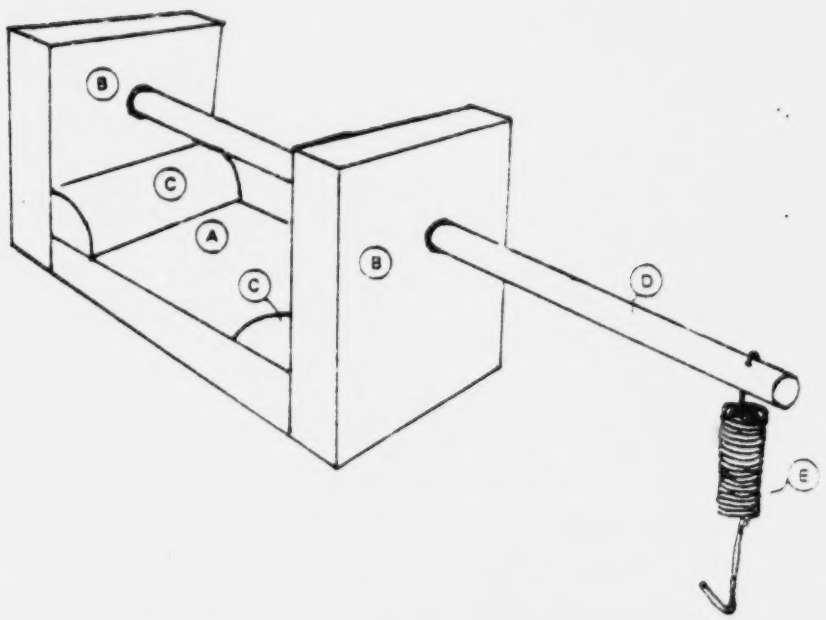


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Spring Holder Jig Item No. 9

MATERIALS

1 - 3 3/4" w x 5/8" t x 5" long plywood board (A)
2 - 3 3/4" w x 5/8" t x 5 1/4" long plywood boards (B)
2 - 3 3/4" long x 5/8" radius quarter-round boards (C)
1 - Aluminum rod 1/2" diam x 12-14" long (D)
1 - Coiled spring (- automobile or truck clutch pedal return spring) (E)

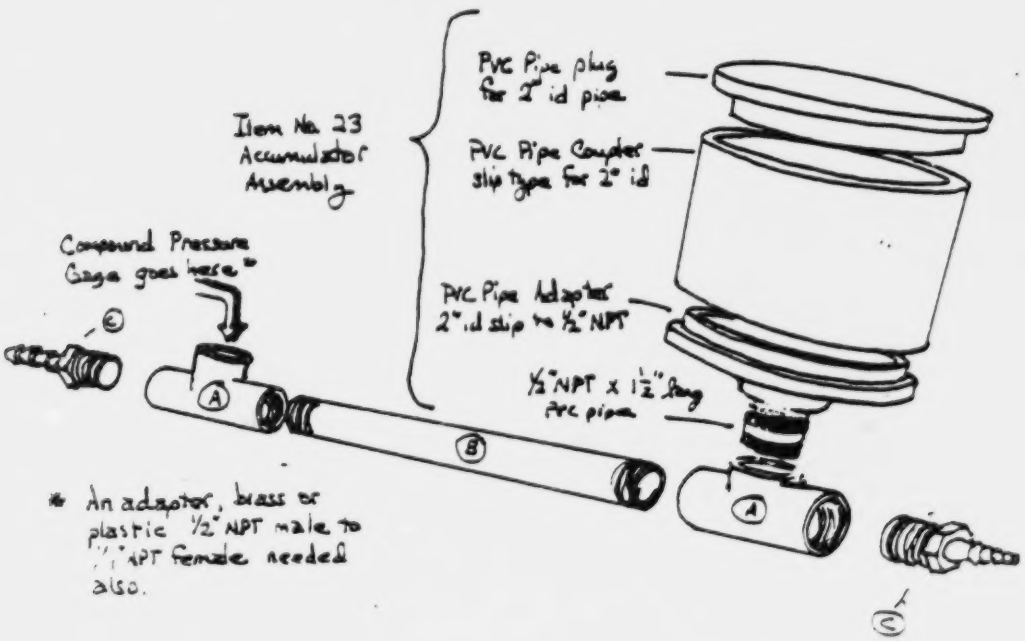


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Air Chamber Assembly Item No. 20

MATERIALS

2 - PVC, 1/2" diam pipe tees with threaded ports Ⓐ
1 - PVC, 1/2" diam pipe 3" long Ⓑ
2 - Tubing barbs, 1/2" NPT to 1/4" tubing Ⓒ
2 - Tubing/hose clamps Ⓓ


PVC Pipe plug for 2" id pipe
Item No. 23 Accumulator Assembly
PVC Pipe Coupler slip type for 2" id
Compound Pressure Gage goes here*
PVC Pipe Adapter 2" id slip to ½" NPT
½" NPT x 1½" long PVC pipe
* An adapter, brass or plastic ½" NPT male to ¼" NPT female needed also.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

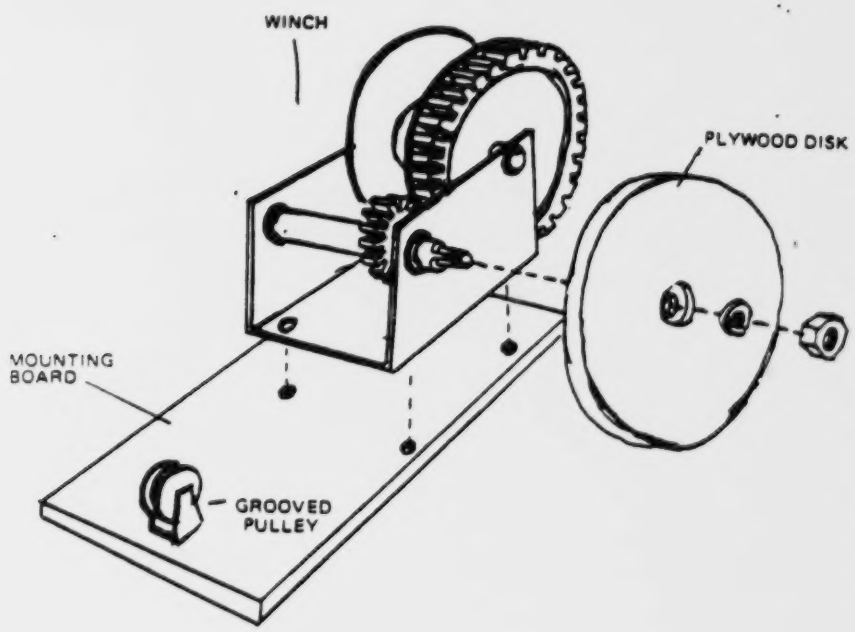
Item Name: Winch Assembly Item No. 43

MATERIALS

1 - Wood board, 10" w x (1/2" - 5/8") t x 14" long
1 - Winch, similar to W.W. Grainger, type 2Z601
3 - Wooden disk, 10" daimeter x 1/2" thick
1 - 1" diam grooved pulley

NOTE: It is important that the winch be able to free-wheel both in and out and that input handle can be removed easily. The handle will be removed to allow the attachment of the disk.

The plywood disk should be grooved to receive the mono-filament line.



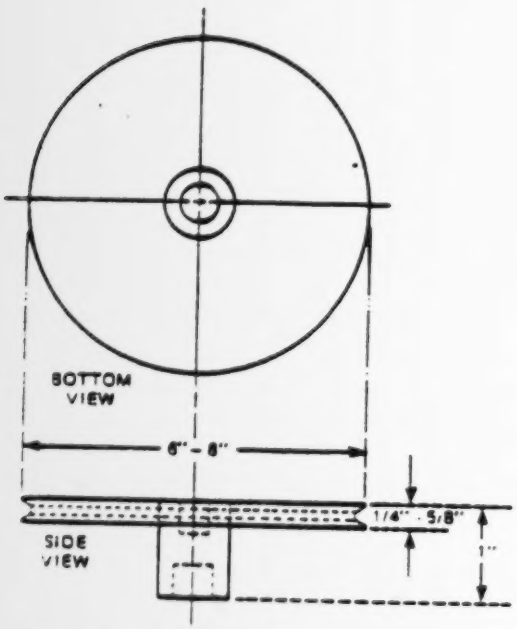
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Weight Stage

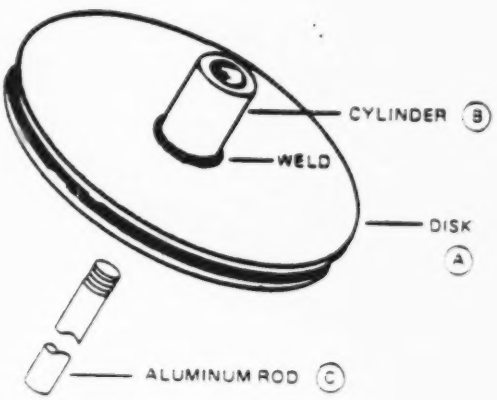
Item No. 45

MATERIALS

1 - 6" to 8" diam aluminum disk, 1/4" to 5/8" thick (A)
1 - Aluminum cylinder, 1" diam x 1" long (B)
1 - Aluminum rod, 8" to 10" long x 3/16" diam, threaded at one end (C)



DRAWING NOT TO SCALE



Note: The aluminum rod is to help the slotted weights stay centered on the stage.

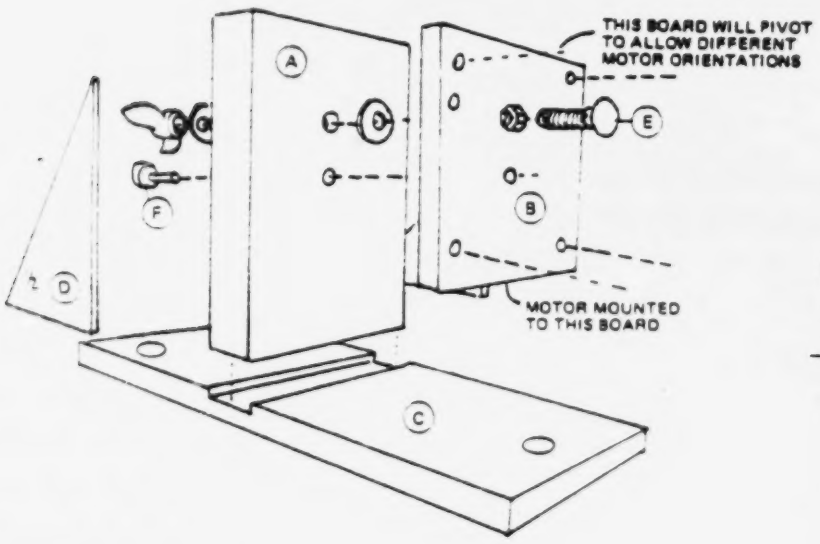
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

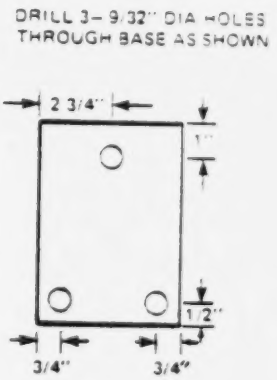
Item Name: Electric Motor Assembly Item No. 52

MATERIALS

1 - 5 1/2" w x 3/4" t x 6 3/4" long solid wood board (A)
1 - 4 1/4" w x 5/8" t x 4 1/2" long plywood board (B)
1 - 5 1/2" w x 3/4" t x 8" long solid wood board (C)
1 - 3 1/2" w x 3/16" t x 5" long wood board (cut diagonally in half) (D)
1 - Permanent magnet DC - 1/16 hp (or less) electric motor Motor should not exceed 8 amps at 12 V DC max
4 - Screw, washer, nut assemblies to fasted motor to board.
1 - 1/2" diam carriage bolt with washers and wing nut (E)
1 - index pin (F)

Additional materials to be available
1 - 2" o.d. drive pulley for motor shaft (to accept 1/8" diam round belts)
1 - 1" to 2" diam x 1" width drum for motor shaft
1 - 3/4" long piece of rubber tubing slightly smaller than shaft diam to act as a shaft coupler.





Ross
3/01/8.

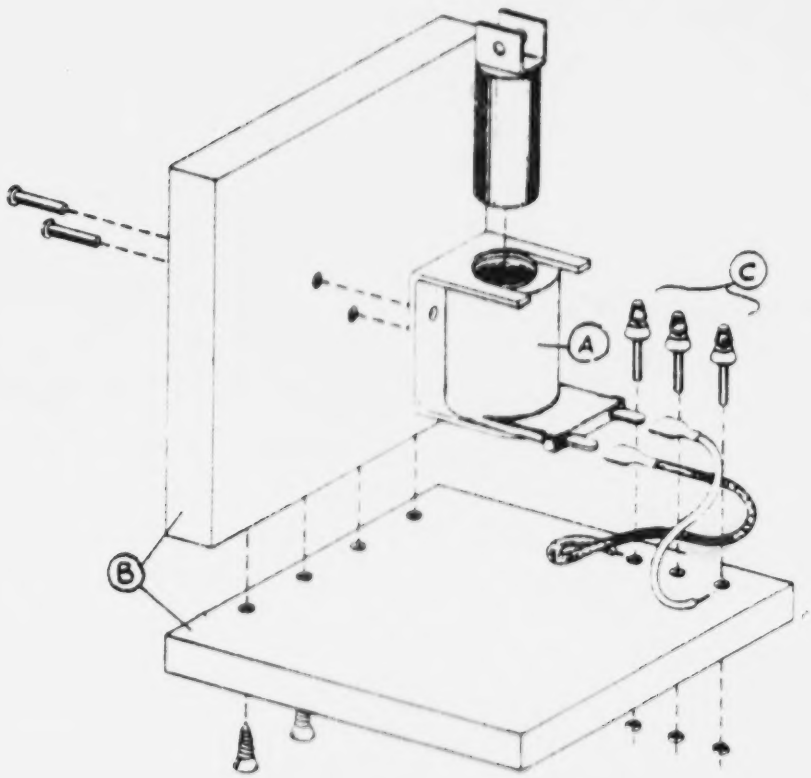
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Solenoid Assembly Item No. 54

MATERIALS

1 - 12 V DC solenoid with 3/4" pull Ⓐ
4 - Wood screws
1 - Mounting frame of 2 - 6" x 4" x 5/8" thick plywood Ⓑ
3 - 5-way binding posts (1 red and 2 black) Ⓒ

Construction:
Cut 2 plywood rectangles and mount together with solenoid and binding posts as shown in figure below.

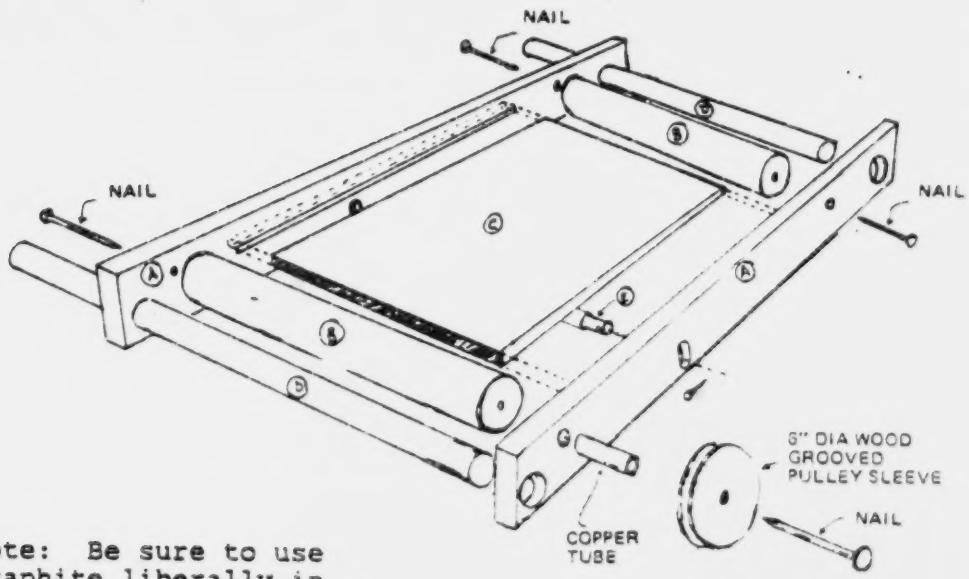


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Conveyor Assembly Item No. 55

MATERIALS

2 - Wood boards 2" w x 1/2" - 5/8" t x 18" long Ⓐ
2 - Wood dowels 1" diam x 2 1/2" long Ⓑ
1 - Wood board - top surface covered with aluminum foil Ⓒ
1/4" t x 2 5/8" w x 10" long
2 - Wood dowels 3/4" diam x 6" long Ⓓ
1 - Wood dowel with plastic straw (2 1/2" long)
1/8" diam x 4" long (Optional) Ⓔ
1 - 2" to 2 1/4" wide belt
NOTE: This belt can be a sanding belt or a section cut out of an automobile tire innertube.
1 - Continuous round drive belt with 1/8" diam



Note: Be sure to use graphite liberally in each nail hole in boards marked "A".

Also, the copper pipe 3/4" long x 3/16" id. acts as spacer and bearing. It keeps the grooved pulley from dragging on the wood board.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

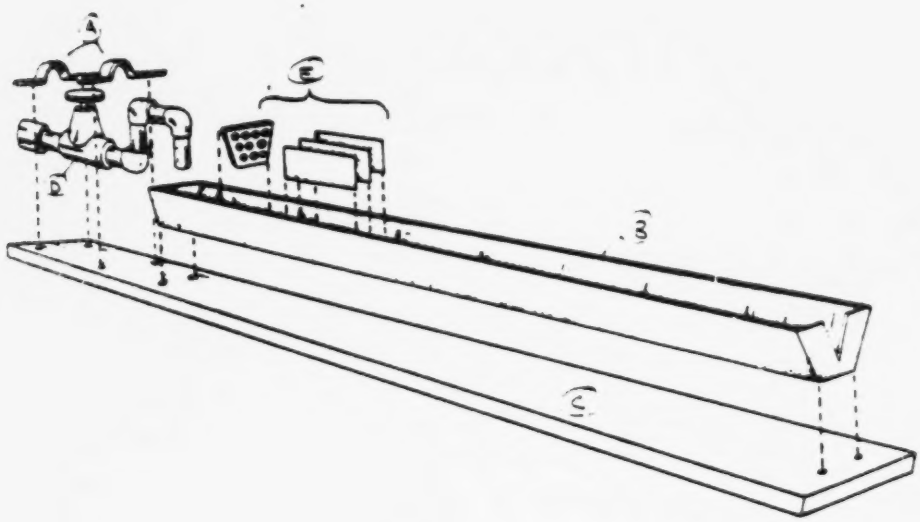
Item Name: Water Channel Assembly Item No. 58

MATERIALS

2 - Pipe clamps Ⓐ
1 - Vinyl plastic or rain gutter, 37" to 42" long x 4 1/2" wide x 2 3/4" high. Ⓑ
1 - Wood board, 46" long x 5" wide x 5/8" thick Ⓒ
3 - PVC 90 elbows
3 - PVC pipe sections
1 - PVC control valve Ⓓ
1 - Baffle and flow straighteners Ⓔ
1 - PVC pipe to hose coupling/connector (female hose connector --male pipe connector)

Assembly:

The flow straighteners should be no less than 4" long x 2" tall x 1/16" thick to no more than 10" long x 2" tall x 1/16" thick. These should be glued across the bottom of the gutter and attached to run exactly parallel to the length.



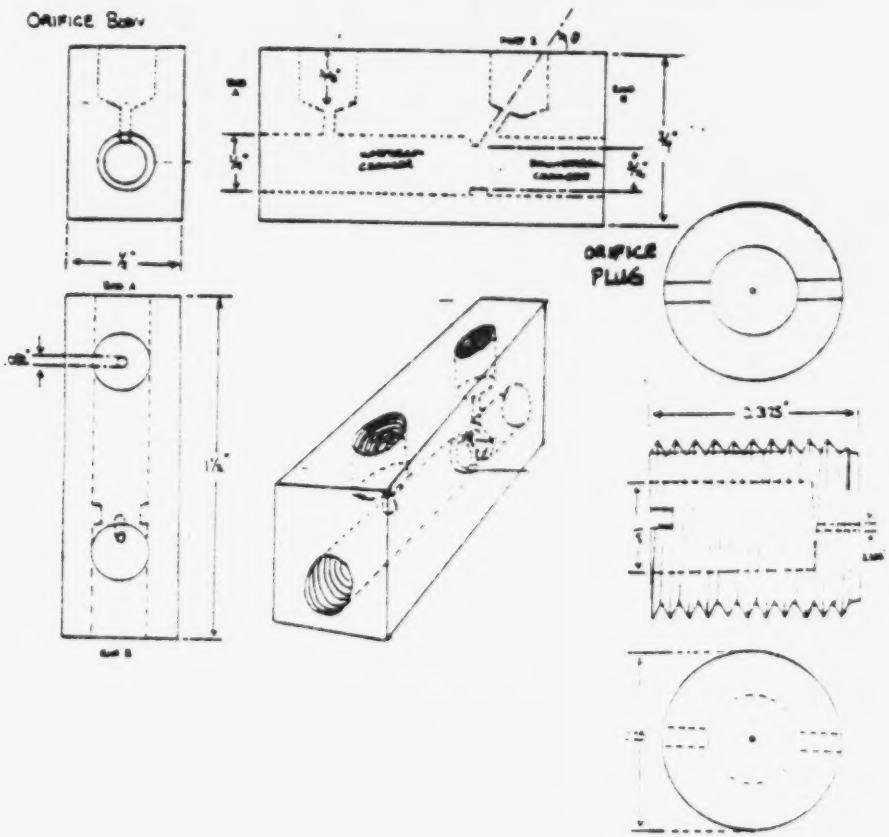
Ross
3/31

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Gas Orifice Assembly Item No. 62

MATERIALS

1 - Orifice plug, preferably brass
4 - 1/4" NPT brass adaptors
1 - Orifice body, plexiglass or acrylic plastic
1 - Plexiglass tube 2" ID x 24" - 1/8" wall thickness recommended. Tube should be drilled and tapped within 2" of the bottom to receive a 1/4" NPT tubing barb.
1 - 3" square glued to top of tube--drilled and taped for 1/4" NPT
2 - 1/4" NPT tubing barb
1 - Plastic tray or pan 4" - 5" deep with 6" wide x 9" long dimensions



ADDITIONAL DATA AND INSTRUCTIONS ON BACK OF PAGE.

PREPARATION OF ORIFICE BODY

Need 1 rectangular plexiglass rod 1/2" w x 3/4" h x 1 1/2"

1. Drill a pilot hole 1/8" diam through the length (1.5")of the block. The hole is not to be centered. This hole should be located 1/4" from 3 sides of the face and 1/2" from the remaining side.
2. Counterbore with 3/16" diam completely through length.
3. Drill and tap for 1/4" - 28 SAE from one end (End A) to a depth of 9/10".
4. Drill and tap for 1/4" - NPT from other end (End B) to a depth of 2/5".
5. Drill 2 pilot holes on the top 1/2" x 1 1/2" face with a 1/8" diam bit to a depth of 3/8". Port 1 should be 0.375" from End A and centered on the 1/2" width. Port 2 should be 0.300" from End B and centered on the 1/2" width.
6. Drill and tap for 1/4" - NPT to a depth of 1/4" for each port.
7. Use a #45 drill (0.082" diam) to drill a hole on center of Port 1 to intersect upstream chamber.
8. Use a #45 drill to drill a 63 degree angle to intersect downstream chamber near orifice plug.

NOTE: Tubing barbs for 1/4" holes come with NPT thread, not with SAE thread. Three of your ports have NPT, one has SAE. Once the orifice plug is installed you may find it necessary to insert an adaptor that would have male 1/4" 28-SAE on one end and female 1/4" NPT on the other.

PREPARATION OF ORIFICE PLUG

Need brass rod 0.25" diam.

1. Run rod through die to thread for 28 turns per inch for a depth of 0.35".
2. Bore from end on center 1/8" diam x 0.25" deep.
3. Counterbore with #97 drill (0.005" diam) to a depth of 3/32".
4. Cut off rod to length of 0.3125".
5. Clean 0.005" diam hole.

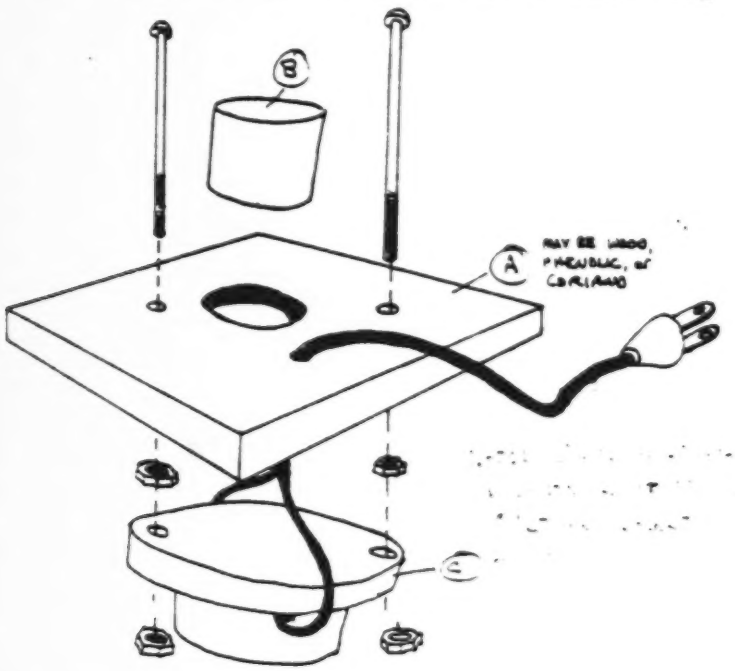
Principles of Technology
- DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Heat Transfer Assembly Set Item No. 68

MATERIALS

For 68A (Used in Lab 3T1)

1 - 7 1/2" to 9" square x 1/2" - 5/8" thick plate (A)
1 - 1" to 1 1/2" diam x 1" long aluminum cylinder (B)
2 - 1" x 3/4" strip of metal tape (aluminum)
1 - Lamp socket subassembly (C)
1 - Standard base 100 W light bulb (D)
1 - AC patch cord wired to the lamp socket subassembly



NOTE:

For lab 3T1, you should run the lamp at full voltage, from the power supply, for no more than 4 minutes. After 4 minutes readjust the power supply AC output to approx. 20% of full setting. Note also that we now recommend the use of a 100 watt lamp instead of the 600 watt heater.

MAKE NOTE OF THESE RECOMMENDATIONS IN YOUR TEACHER GUIDE

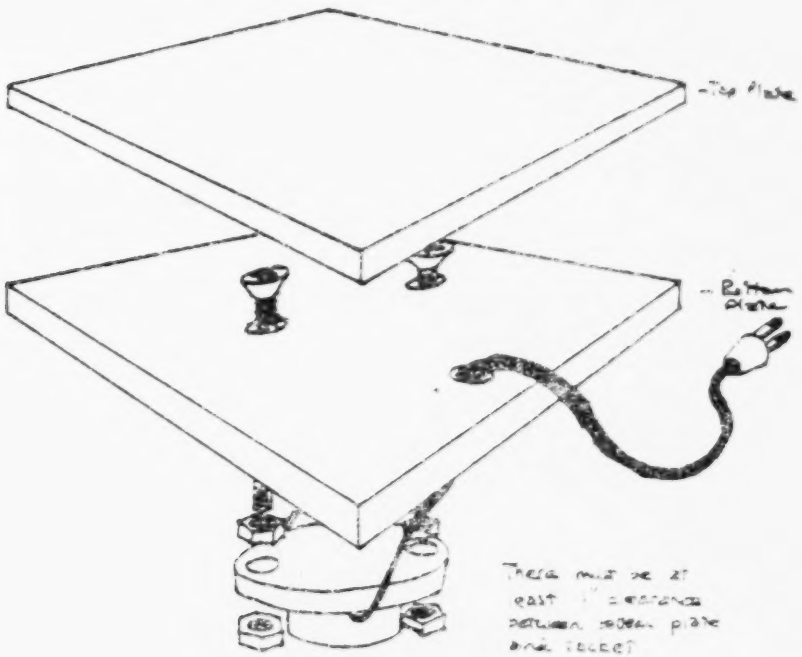
INFORMATION ON 68B ON BACK OF PAGE

MATERIALS

For item 68B (used in Lab 4T1)

2 - Aluminum plates, 3/16" thick x 8" wide x 8" long
  - items from 68A C , D , and F
2 - bolts, 3 1/2" long x 10-32 thread

NOTE: The upper aluminum plate will be untouched except for the edges being deburred and rounded to remove any sharp edges. The bottom aluminum plate will be prepared as shown below.



NOTE:

Once more, for this lab (4T1) we recommend:

1. Replace the 660 watt resistance heater with a 100 watt light bulb.
2. Allow full voltage (110 V AC) to be applied for no more than 4 minutes.
3. After 4 minutes reduce the input voltage to 40% of full.

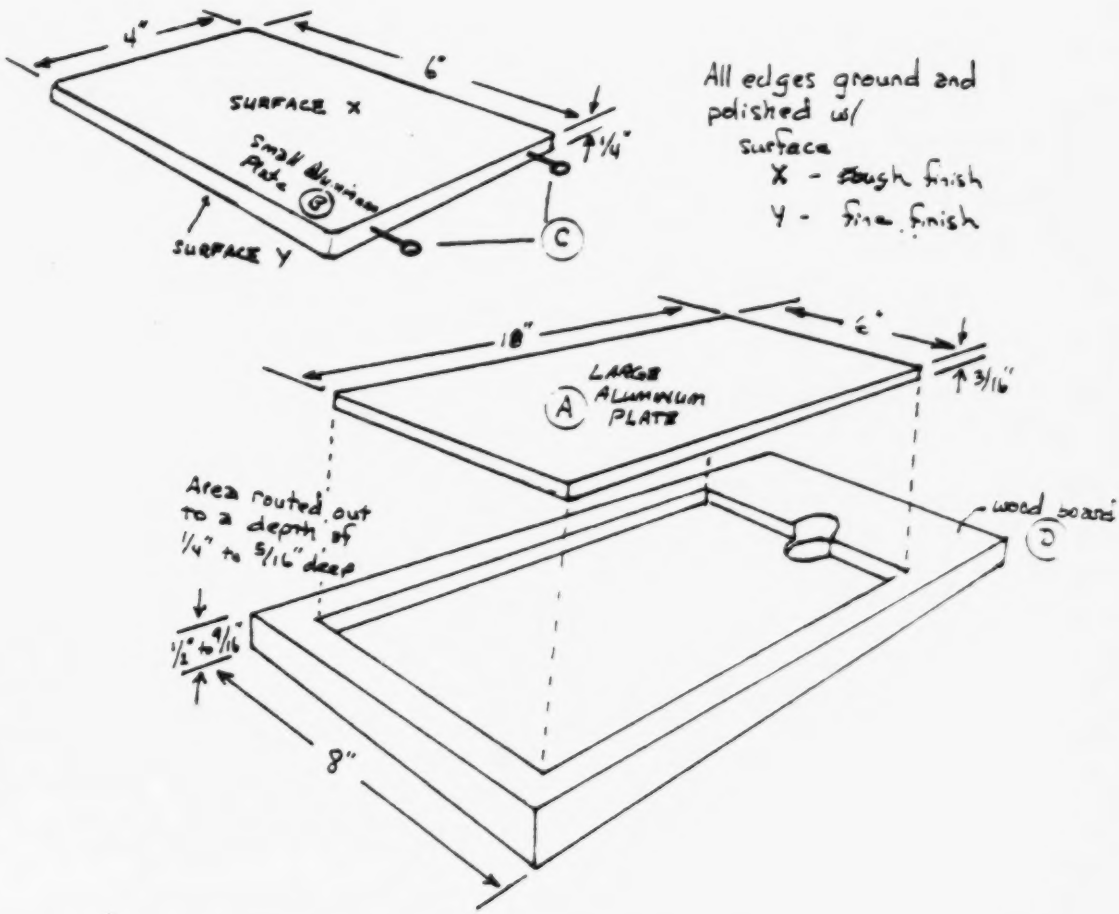
MAKE NOTE OF THESE RECOMMENDATIONS IN YOUR TEACHERS GUIDE.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Friction Plate Assembly Item No. 71 & 72

MATERIALS

1 - Lg. aluminum plate, 6" x 18" x 3/16", (A)
1 - Sm. aluminum plate, 4" x 6" x 1/4", (B)
2 - Minature eye screws (C)
1 - Wood board, 8" x 24" x 1/2" to 9/16" (D)



CORD/
Ross
3/01/8

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Air Flow Assembly Item No. 73

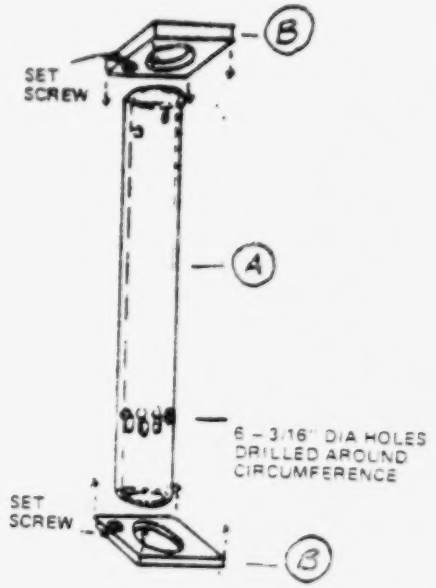
MATERIALS

1 - 36" long x 2" id tube, plexiglas (A)
2 - 4" x 4" squares, plexiglas with 1-2" diam hole drilled on center in each, 1/4" thick. (B)
3 - Flow objects (item no. 74)
These objects are to be made of wood or plastic, 3-shapes. Each shape w/ the same cross-sectional diam (d).
NOTE: The value (d) must be between 70% and 80% of the value of the cross-sectional diam of the unrestricted flow tube. Thus d = 1.4" to 1.6"

CONSTRUCTION

Glue squares at each end of the tube so that holes in squares coincide with that of the tube.

Squares should have a 3/8" diam hole drilled in one corner of each square and aligned to the same side. These holes should be drilled and tapped for set screws.



USE NOTE:

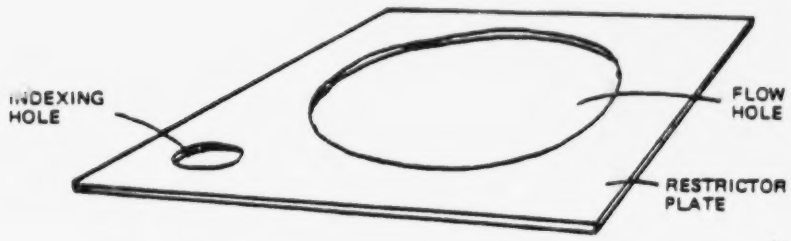
Use a spring balance (0-5 N range). Suspended it above air flow apparatus. The with a length of monofilament line connect the spring balance and drag objects.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Flow Restrictor Set Item No. 79

MATERIALS

8 - 4" x 4" x 1/32" aluminum plates



CONSTRUCTION

Each of the 8 plates is identical except for the size of the flow hole. The diam of the flow hole in each plate is calculated to be a percent of the cross-sectional area of the unrestricted air flow device. The relationship of diam to the percent of cross-sectional area is shown by the following chart.

% of OPEN AREA	DIAMETER MULTIPLIER
100%	D
90	0.95 D
80	0.89 D
70	0.84 D
60	0.77 D
50	0.71 D
40	0.63 D
30	0.55 D
20	0.45 D

NOTE: The diam multiplier has been rounded off to only 2 places, thus the true percent of open area resulting is in error by 0.6% at worst.

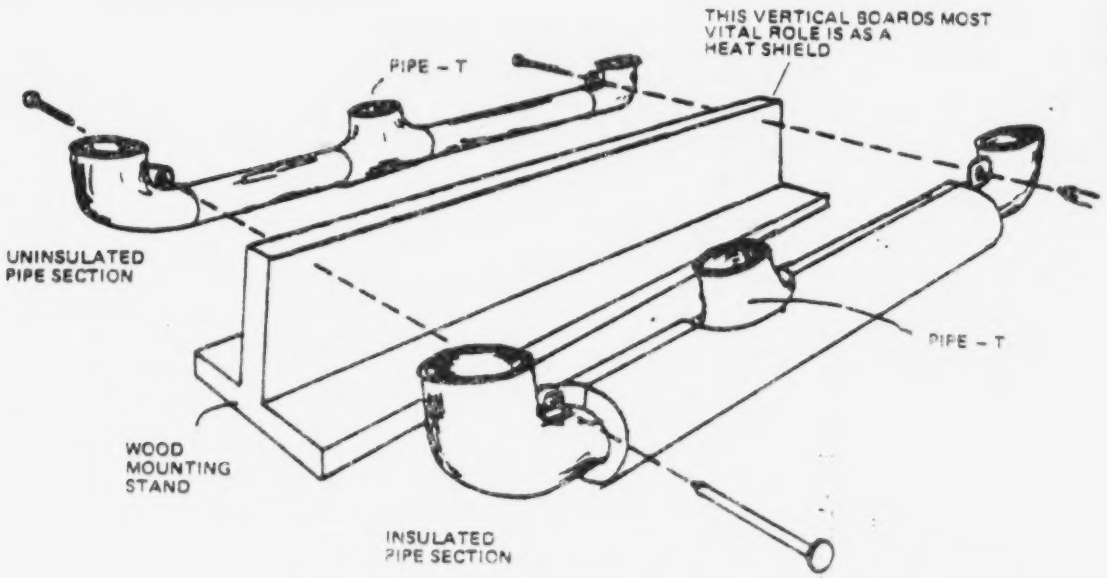
COAL [illegible]
Ross
3/01/86

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Thermal Pipe Assembly Item No. 85

MATERIALS

4 - tubes, copper, 16" long x 1" diam
2 - pipe tees, copper
4 - pipe elbows, copper
1 - thermal insulation 34" long tube for 1" diam pipes
1 - wood mounting stand


THIS VERTICAL BOARDS MOST VITAL ROLE IS AS A HEAT SHIELD
PIPE - T
UNINSULATED PIPE SECTION
PIPE - T
WOOD MOUNTING STAND
INSULATED PIPE SECTION

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

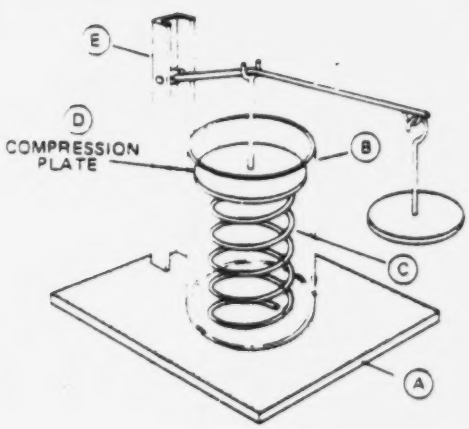
Item Name: Spring Test Assembly

Item No. 87

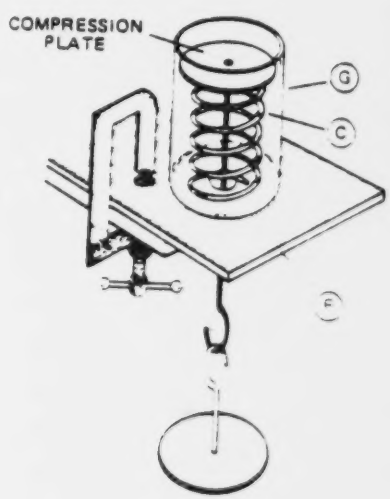
MATERIALS

For Design A
1 - Base, 4" x 4" x 3/4" wood (A)
1 - Tube, 2" diam x 5" tall (B)
1 - Spring, coil type, 1 7/8" diam x 3 1/2" long (C)
1 - Compression plate, circular disk 1 15/16" diam x 1/4" aluminum with vertical 3" long rod mounted on center (rod diam 1/4") (D)
1 - Vertical support rod with lever arm (E)

For Design B
1 - Base, 6" x 4" x 3/4" wood (F)
1 - Tube, 2" diam x 5" tall (G)
1 - Spring, coil type (same as "C" above)
1 - Compression plate (same specs as "D" above except vertical rod must be 5" to 6" long).



DESIGN A



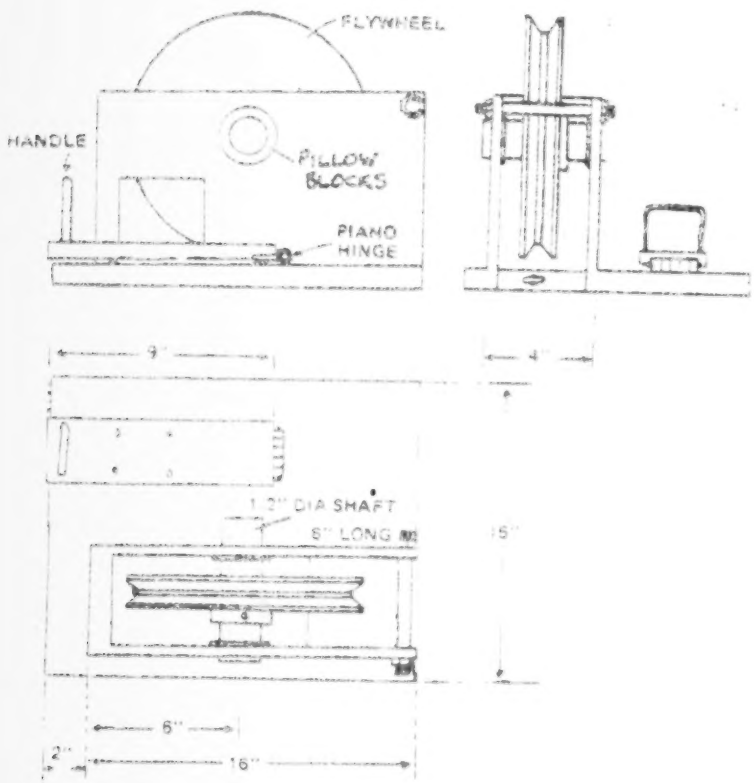
DESIGN B

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Flywheel Assembly Item No. 88

MATERIALS

Base 5/8" t x 15" x 18" plywood
Sides - 1/2" t x 16" x 12" plywood
Lever - 1/2" t x 9" x 4" plywood
Piano hinge 3" wide
Flywheel - cast iron pulley sheave 8-10" diam x 3/4" wide with weight of 4 to 5 lb
Shaft - 1/2" diam x 6" long
Threaded bolt 5" long x 1/4" diam
2 - Pillow block with bearings for 1/2" diam shaft
Eye screw 3/4" long - wood screw



ADDITIONAL INFORMATION ON BACK OF THIS PAGE.

CORD/PT
Ross

All materials listed below are referenced to W.W. Grainger, Inc., cat. #367

Pulley sleeve, 8 1/4" diam	stk # 3X598	$19.73 ea
Bushing set, for 1/2" diam shaft malleable split type	stk # 3X884	6.64 set
Pillow block set Ball bearing for 1/2" diam shaft	stk # 1A396	16.94 set
Shaft collars	stk # 2X568	.59 ea

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Hydraulic Flow and Shock Assembly Item No. 91

MATERIALS COST OF ACCUMULATOR DEVICE

Item-Description	Cost Each	Number Needed	Total Price
Adaptor, garden hose to 1/2" pipe thread	1.80	2	3.60
Adaptor, 1/2" pipe thread to 1/2" pipe slip	0.33	12	3.96
Adaptor, 1/2" pipe thread male to 1/4" NPT female	0.99	2	1.98
Valve, gate type with 2 female 1/2" pipe thread	7.90	1	7.90
Valve, ball type with 2 slip PVC	2.99	1	2.99
Tee, PVC with 3 female 1/2" pipe thread	0.59	3	1.67
Pipe nipple 1/2" male to male PVC	0.80	1	0.80
1/2" PVC schedule 40 x 24" long	0.80	1	0.80
1/2" vinyl tubing	0.8t/ft	1/3 ft	0.29
TOTAL MATERIALS COST			$31.99

The prices lsited are retail prices in Waco, Texas. Prices for Teflon pipe tape and PVC pipe cement are not included--nor the cost of assembly in labor.

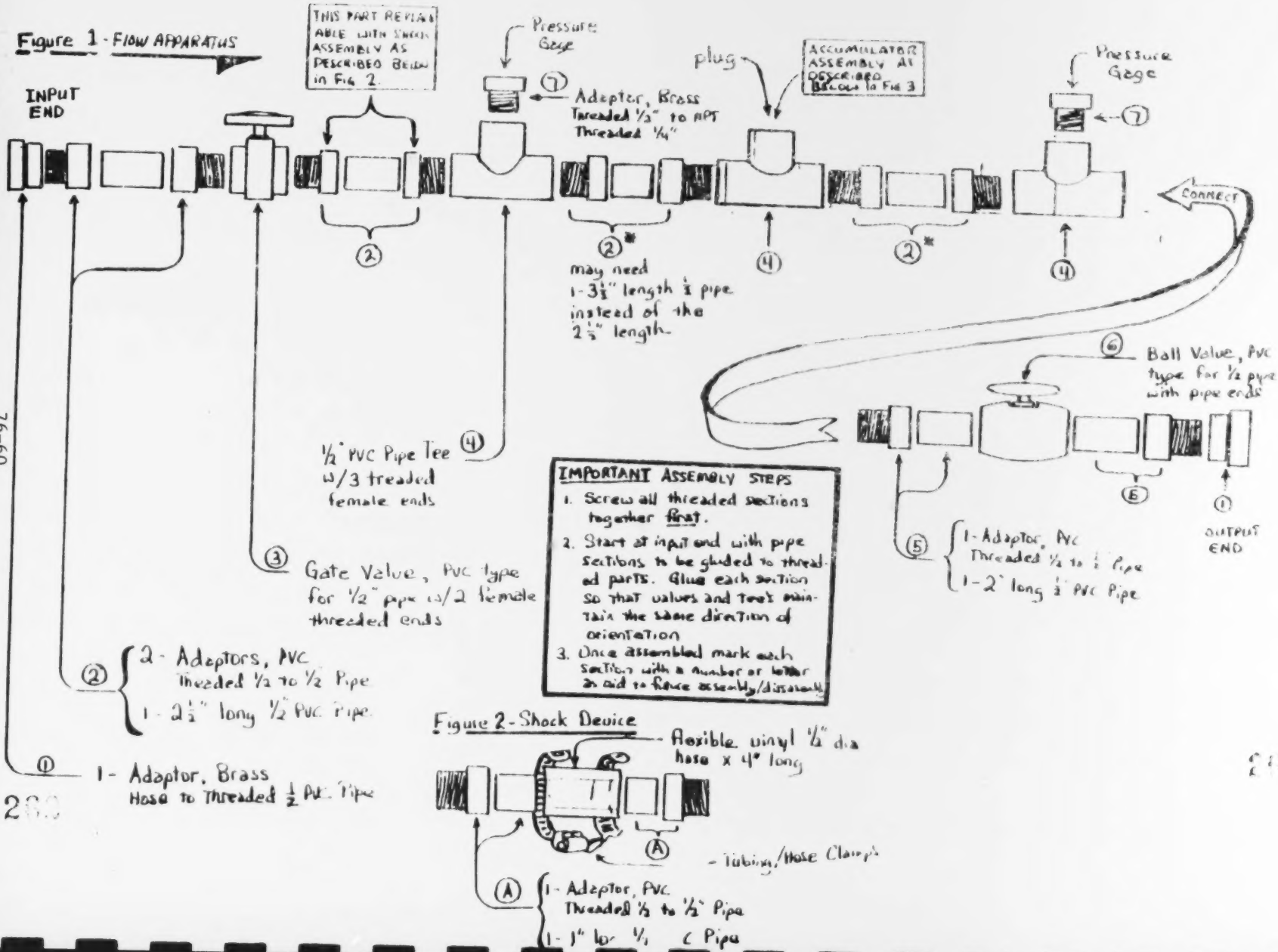


Figure 1 - FLOW APPARATUS
INPUT END
THIS PART REPLACEABLE WITH SIMILAR ASSEMBLY AS DESCRIBED BELOW in Fig 2.
Pressure Gage
⑦ Adapter, Brass Threaded ½" to NPT Threaded ¼"
plug
ACCUMULATOR ASSEMBLY AS DESCRIBED BELOW in Fig 3
Pressure Gage
⑦
CONNECT
②
②* may need 1-3½" length ½ pipe instead of the 2½" length.
④
②*
④
⑥ Ball Valve, PVC type for ½ pipe with pipe ends
½" PVC Pipe Tee ④ w/3 treaded female ends
③ Gate Valve, PVC type for ½" pipe w/2 female threaded ends
IMPORTANT ASSEMBLY STEPS
1. Screw all threaded sections together first.
2. Start at input end with pipe sections to be glued to threaded parts. Glue each section so that valves and tees maintain the same direction of orientation
3. Once assembled mark each section with a number or letter to aid in future assembly/disassembly
⑤ 1 - Adaptor, PVC Threaded ½ to ½ Pipe
1 - 2" long ½ PVC Pipe
⑤
E
①
OUTPUT END
② 2 - Adaptors, PVC Threaded ½ to ½ Pipe
1 - 2½" long ½ PVC Pipe
① 1 - Adaptor, Brass Hose to Threaded ½ PVC Pipe
Figure 2 - Shock Device
Flexible vinyl ¼" dia hose x 4" long
Ⓐ
- Tubing/Hose Clamps
Ⓐ 1 - Adaptor, PVC Threaded ½ to ½" Pipe
1 - 1" for ½ C Pipe

76-60

280

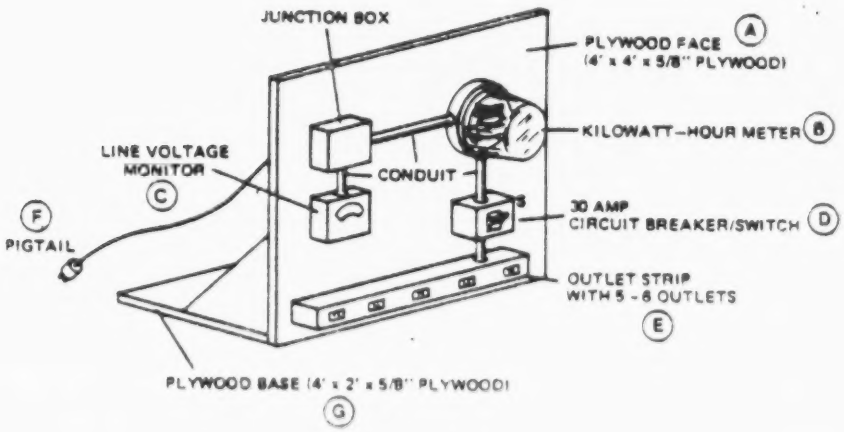
283

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Kilowatt-hour Meter Assembly Item No. 98

MATERIALS

2 - 4'w x 5/8" x 4' long plywood (A) & (G)
1 - Kilowatt-hour meter base socket
1 - Kilowatt-hour meter (B)
1 - Line voltage monitor (C)
1 - 30-A circuit breaker/switch (D)
1 - multiple outlet strip (with 5 or 6 outlets) (E)
1 - Pig tail connector (3-wire) (F)
- Conduit and junction boxes


JUNCTION BOX
PLYWOOD FACE (A)
(4' x 4' x 5/8" PLYWOOD)
KILOWATT-HOUR METER (B)
LINE VOLTAGE MONITOR (C)
CONDUIT
30 AMP CIRCUIT BREAKER/SWITCH (D)
(F) PIGTAIL
OUTLET STRIP WITH 5 - 6 OUTLETS (E)
PLYWOOD BASE (4' x 2' x 5/8" PLYWOOD) (G)

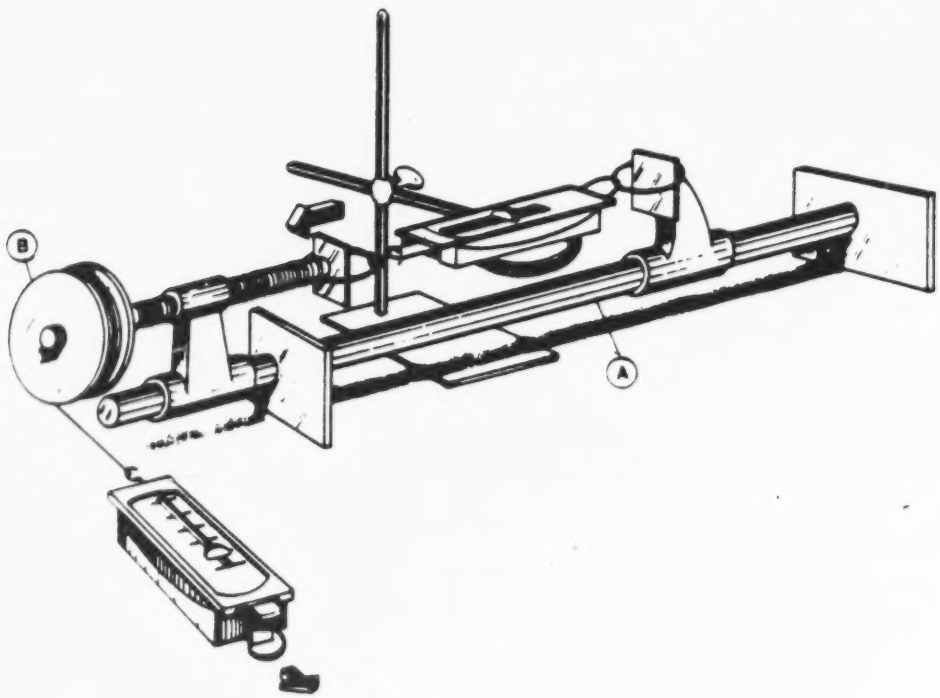
CCRD/PT
Ross
3/01/86

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Pipe-Clamp Assembly Item No. 101

MATERIALS

1 - 1" diam x 4' long iron or steel pipe (A)
1 - set of bar clamps, one end with adjustable screw mechanism
1 - 8" diam disk (B)



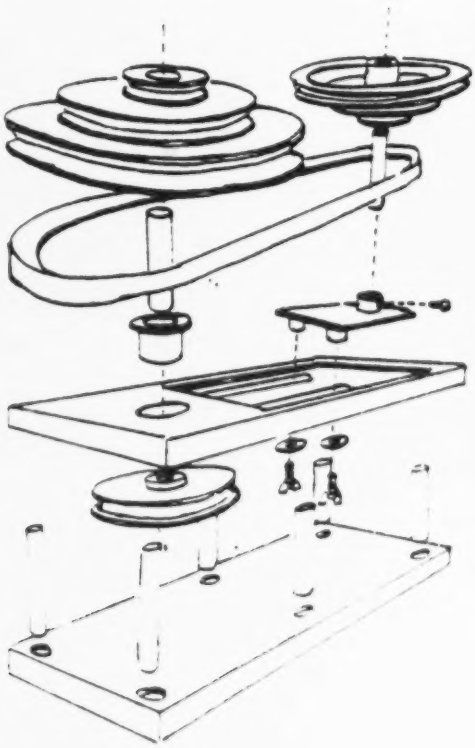
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Belt Drive Trainer

Item No. 104

MATERIALS

2 - Multiple step pulleys, V-belt type
2 - Shafts - 12 mm diam
2 - Plywood Boards 6" w x (1/2" - 5/8") t x 22" long
6 - 1" diam x 4" long wood dowels
1 - V-belt to fit
1 - Fixed bearing assembly
1 - Movable bearing assembly
2 - Timing belt pulleys
1 - Timing belt



The two multiple-level pulleys can be removed along with the V-belt and the cogged wheels with cogged belt replace these on the same shaft.

Specifications for the timming belt and the timming belt pulley are from Stock Drive Products. SEE ITEM NO. 201 for information on these.

3 mm pitch	3 mm pitch
300 mm length	Double flange
100 grooves	8.3 cm diameter flange
9 mm width	12 mm bore
	80 grooves
	22 mm width

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Hydraulic Jack

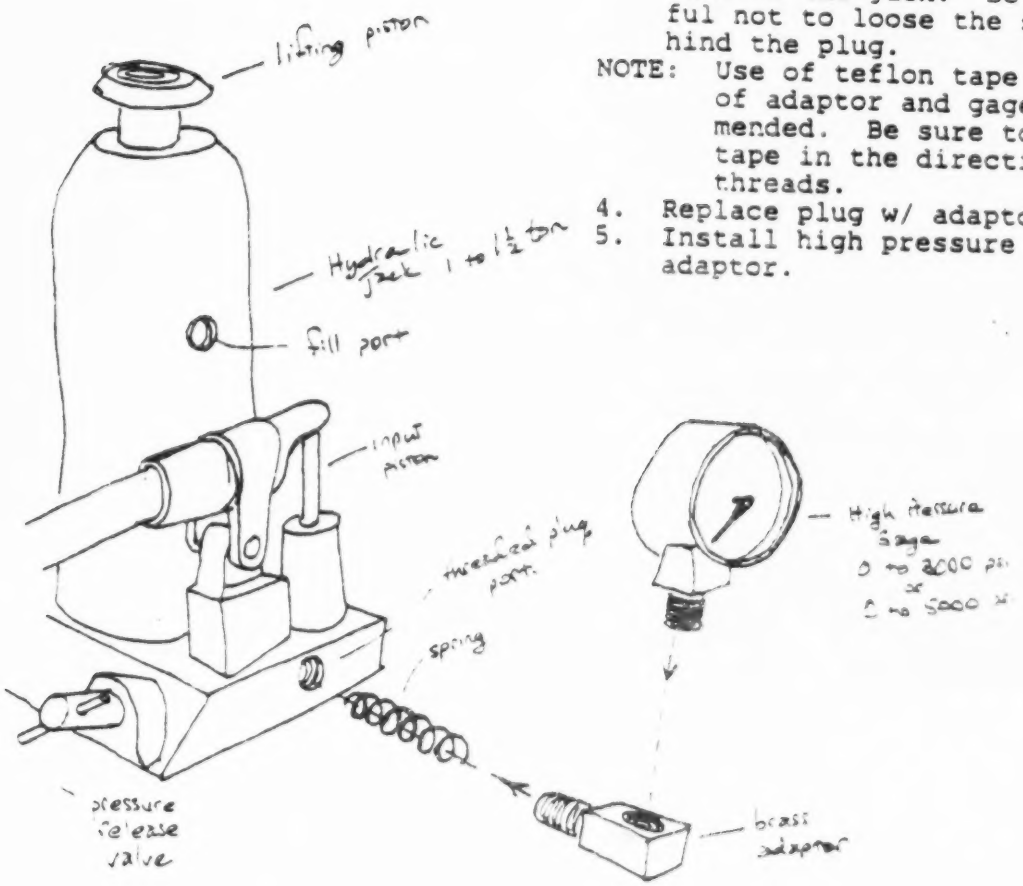
Item No. 105

INSTRUCTIONS FOR MODIFICATION

1. Open pressure release valve.
2. Lay jack on side w/ plug port up.
3. Remove threaded plug in the base of the jack. Be very careful not to loose the spring behind the plug.

NOTE: Use of teflon tape on threads of adaptor and gage is recommended. Be sure to wrap tape in the direction of the threads.

4. Replace plug w/ adaptor.
5. Install high pressure gage on adaptor.



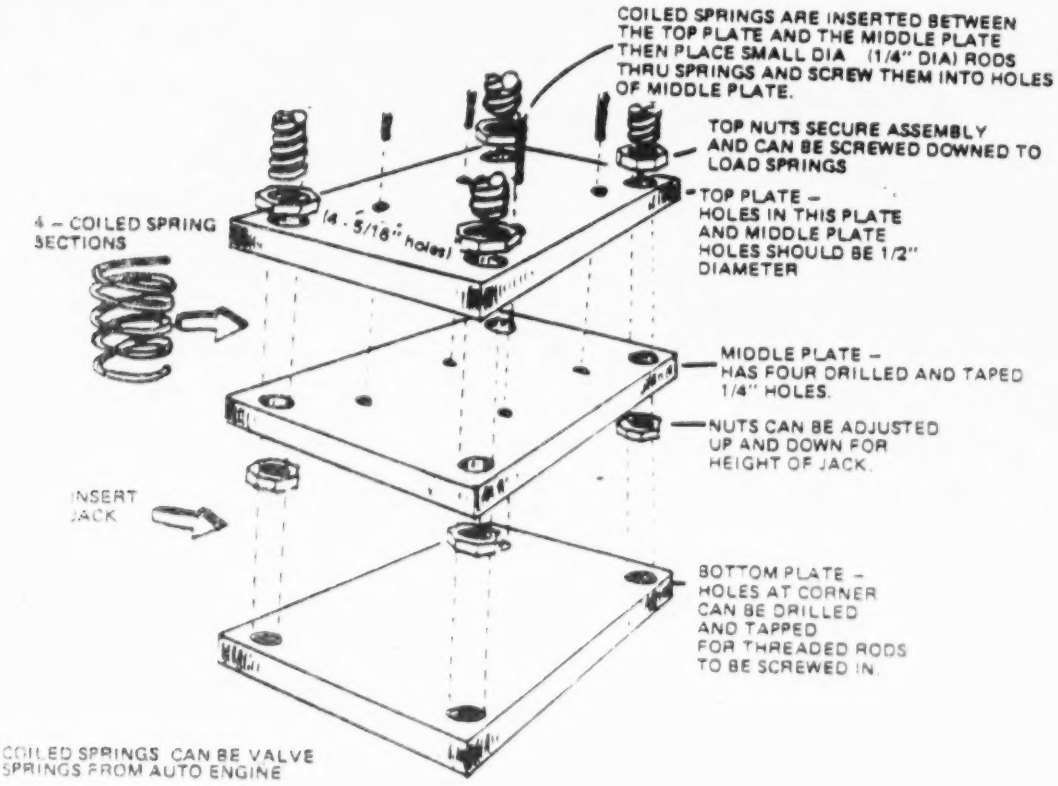
NOTE: On some hydraulic jacks there is a rubber or plastic seal behind the threaded base plug. This must also be removed, but do so with care.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Pressure Stage Item No. 106

MATERIALS

3 - 1/2" t x 3" d x 4" long (minimum)
4 - 3/8: diam x 16" long threaded rods
16 - Heavy-duty nuts
2 - Strong coiled springs
4 - 1/4" diam x 8" long threaded bolts

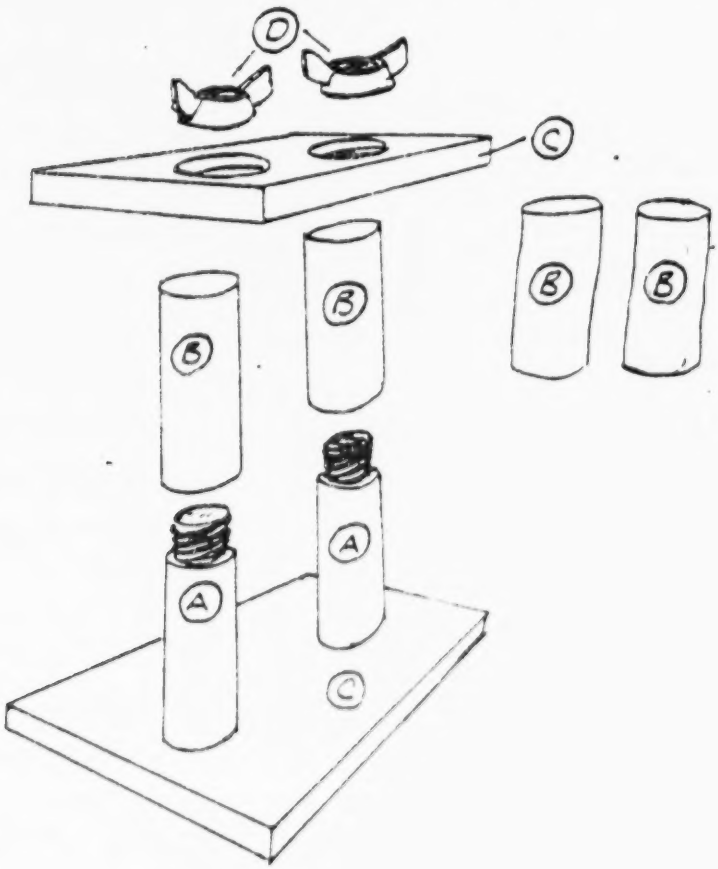

COILED SPRINGS ARE INSERTED BETWEEN THE TOP PLATE AND THE MIDDLE PLATE THEN PLACE SMALL DIA (1/4" DIA) RODS THRU SPRINGS AND SCREW THEM INTO HOLES OF MIDDLE PLATE.
TOP NUTS SECURE ASSEMBLY AND CAN BE SCREWED DOWNED TO LOAD SPRINGS
TOP PLATE – HOLES IN THIS PLATE AND MIDDLE PLATE HOLES SHOULD BE 1/2" DIAMETER
4 – COILED SPRING SECTIONS
(4 - 5/16" holes)
MIDDLE PLATE – HAS FOUR DRILLED AND TAPED 1/4" HOLES.
NUTS CAN BE ADJUSTED UP AND DOWN FOR HEIGHT OF JACK.
INSERT JACK
BOTTOM PLATE – HOLES AT CORNER CAN BE DRILLED AND TAPPED FOR THREADED RODS TO BE SCREWED IN.
COILED SPRINGS CAN BE VALVE SPRINGS FROM AUTO ENGINE

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Transformer Assembly Item No. 108

MATERIALS

2 - 4" long x 1/2" diam steel bolts (A)
4 - 3" long x 1/2" diam plastic tubes (B)
2 - 3/16" t x 4" long x 3" w soft iron plates (C)
2 - Wing nuts (D)



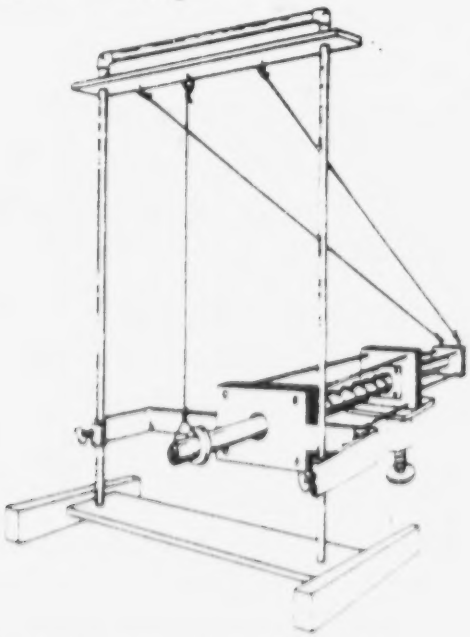
NOTE: Weld bolts to bottom plate with centers 2 1/2" apart.

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Impulse Measurement Assembly Item No. 200

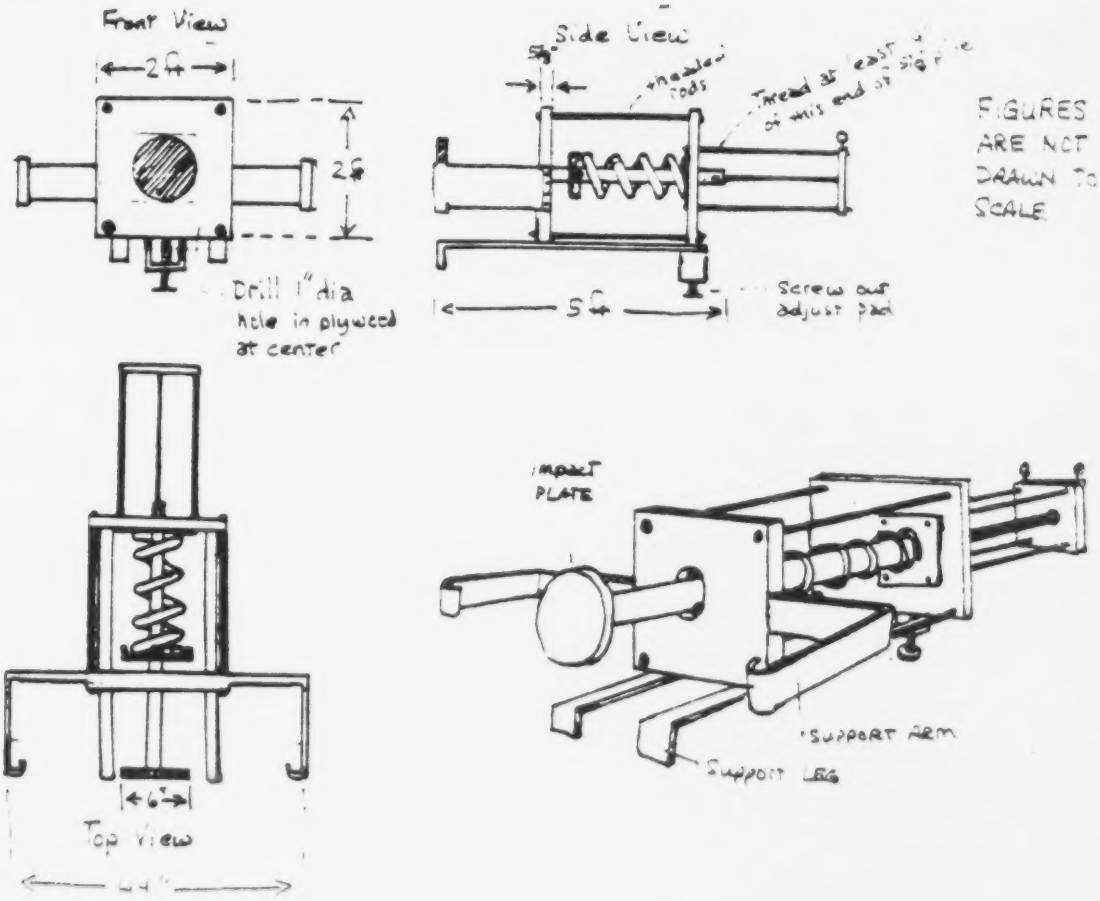
MATERIALS

2 - 2' x 2' x 5/8" t plywood board
1 - 7/8" id steel pipe x 5' long
1 - Impact plate, 6" diameter steel x 3/8" t
1 - 1' x 1' x 5/8" t plywood board
Coil Spring - 3" to 5" diam x 12" x 18" long must be able to withstand 185 to 220 ft-lb energy
8 - 7/16" diam threaded rods 3 ft long
32 - steel washers 1" diam with 7/16" hole
48 - nuts 7/16" diam hole
1 - steel plate 3/16" x 1' square
2 - eyebolts 3/16" diam
2 - threaded collars for od of 5/8" diam pipe
1 - smooth steel pipe 1/2" diam x 4' long
2 - steel support arms
2 - steel support legs
1 - adjustable height leg
6 - 1/4" balls, steel



NOTE: This assembly is intended as an accessory to the heavy-duty support stand (item no. 1). Dimensions and configuration may need to be different due to support and coil spring actually on hand.

FIGURES AND ADDITIONAL DATA ON THE BACK OF THIS PAGE.


Front View
2"
2"
Drill 1" dia hole in plywood at center
Side View
threaded rods
Thread at least 3" of this end
5"
Screw out adjust pad
FIGURES ARE NOT DRAWN TO SCALE
IMPACT PLATE
SUPPORT ARM
SUPPORT LEG
6"
Top View
14"

Information on materials for preparing your own spring.

Use #312 wire
OD of spring 3.2"
ID of spring 2.7"
Length of spring 15" to 13"
Number of coils = 20 to 25
Ground and squar ends.
k = 33 lb/in

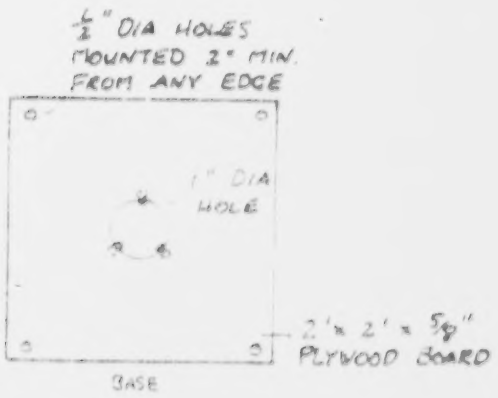
Impact Head Assembly

Weld impact head to one end of 7/8" pipe and thread the last 6"-8" of other end.

For each board: mounting the impact head assembly

* Drill 3 holes 120 apart with a diam of 5/16" and a depth of 3/16".
* Place a number of layers of felt in each hole to reach a thickness of 5/32".
* Liberally coat top layer of felt with graphite.
* Place 1/4" steel balls in holes and hold in place with 6" long strip of tape.
* Insert 7/8" diameter pipe, then remove strips of tape.

The result is that the pipe is suspended and guided by only three points of contact at each board. And these points of suspension are lubricated.



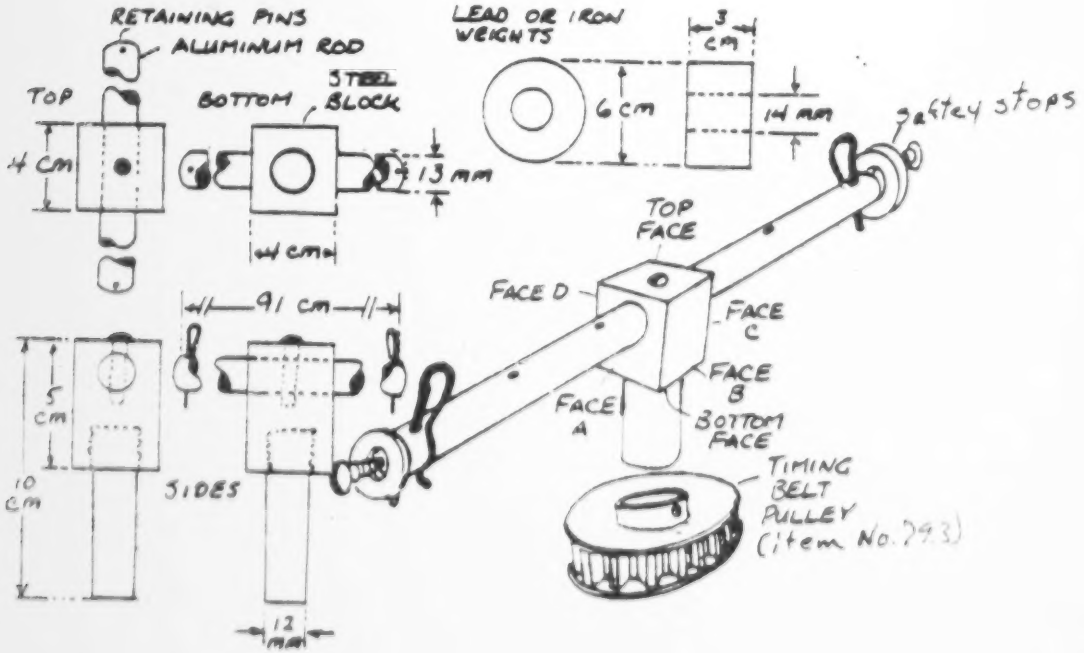
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Moment of Inertia Assembly Item No. 201

MATERIALS

Steel block, 4 cm x 4 cm x 5 cm
Aluminum rod, 13 mm diam x 91 cm
Steel rod 7 1/2 cm x 12 mm diam
2 - iron (or lead) disk-shpaed weights
4 - retaining pins
2 - Saftey stops

NOTE: DRAWINGS ARE NOT DONE TO SCALE



FABRICATION STEPS AND ADDITIONAL DATA ON BACK OF PAGE.

This assembly is intended as an accessory to the Belt Drive trainer (item 104)

VENDOR REFERENCE SOURCE

Timing Belt Pulleys - double flange
sdp* cat. no. 6Z23M080DF091
flange diam = 8.3 cm
OD = 7.56 cm
# of grooves = 80
Bore = 12 mm
Hub diam = 22 mm
3 mm pitch
Width = 22 mm
Lexan reinforced fiberglass with Al insert (knurled)

Timing Belt
sdp cat. no. 6R23M100090
3 mm pitch
300 mm long
Nylon covered, fiberglass reinforced neoprene

Aluminum Rod
Standard support rod from Sargent-Welch
91 cm long x 13 mm diam
cat. no. S-78454-D

*sdp - Stock Drive Products
55 South Denton Ave
New Hyde Park, New York 10040
(516) 328/0200

FABRICATION STEPS

Steel Block
1. Drill a 13-mm diam hole from FACE A to FACE C. Center of hole should be 2 cm from TOP FACE and FACES B and D.
2. Drill and tap a 5-mm diam hole 25 mm deep at center of top face.
3. Drill and tap a 10-mm diam hole 20 mm deep in bottom face at center.

Aluminum Rod
1. Measure to exact center of length of rod and drill an oversized 5 mm hole completely through rod.
2. From edge of hole measure 44 cm down length (in both directions) and drill a 3-mm hole completely through rod.
3. From edge of center hole measure 21.5 cm down length (in both directions) and drill a 3 mm hole completely through rod.

Steel Rod - 10 mm diam
1. Mark one end of rod 2 1/2 cm from the end.
2. Thread rod to this depth.

Principles of Technology
- DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Fluid Momentum Assembly Item No.: 202

MATERIALS:

PVC Components; all 1/2" diameter size, all schedule 20
- 4 - Straight pipe sections, 6" long
- 8 - Pipe adaptors, slip to NPT female
- 9 - Tubing barbs, NPT male to barb
- 1 - Air chamber assembly (Item no.20)
- 2 - Elbows: 2-90 , 1-slip type, 1-slip type to NPT male .

2 - Flexible plastic tubing-accordian pleated 10" long and 1/2" diam
8 - Hose clamps; adjustable 7/16" diameter to 1 1/16" diameter
4 - Pipe hold-down bracket
1 - Compound pressure gage (Item no. 21)
1 - Accumulator assembly (Item no. 22)
- Assorted wood screws and 1 eye-bolt screw

Wood Components:
- 1 - Mounting base; plywood, 3/8" - 1/2" t x 4' x 2' w
- 2 - Wood dowels; 1/4" diameter x 12-14" long
- 2 - Wood blocks; both 1" tall x 3/4" thick, 1 - 3" , 1 - 6"

CONSTRUCTION DETAILS:

I. Reaction Components

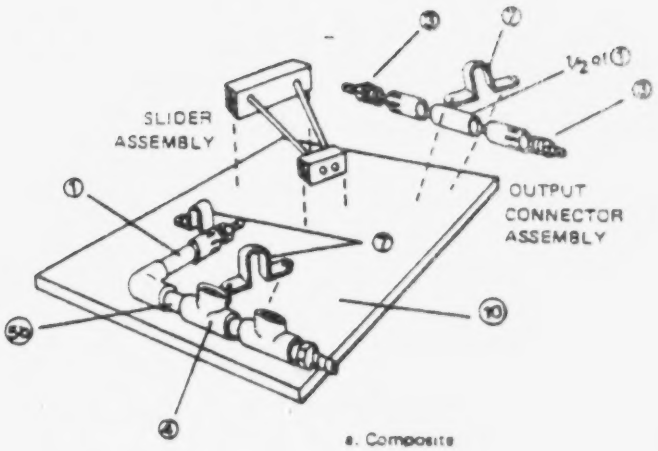
a. 90° degree bend types

ADDITIONAL FIGURES ON BACK OF PAGE.

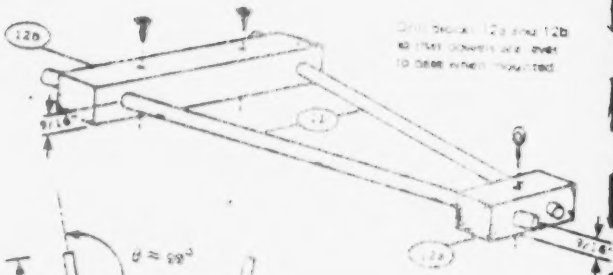
II. Work Base

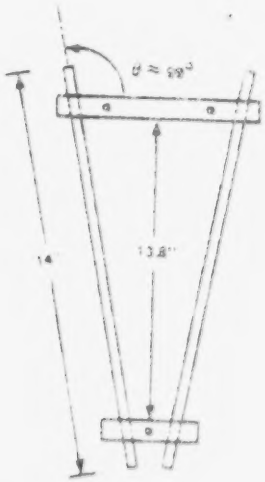
The flex hose is available from:

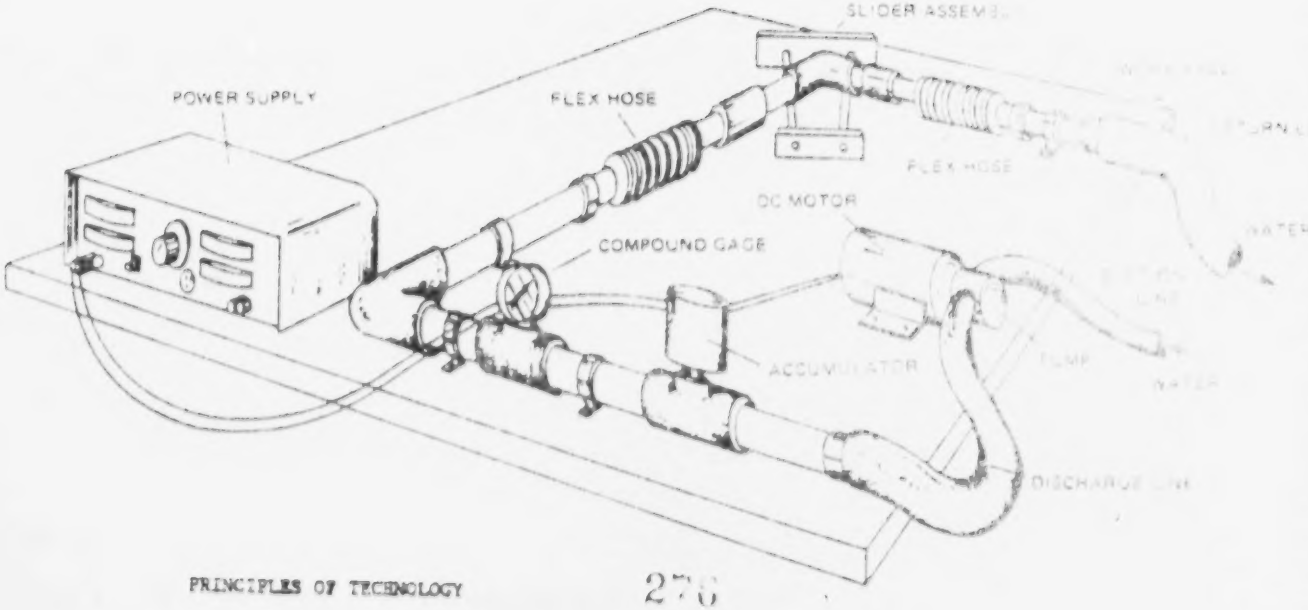
Nautical Rubber Co.
Okland Corner
8980 Route 108
Columbia, MD 21045
at a cost of $0.83 per foot of 3/4" o.d. "bilge hose".



a. Composite





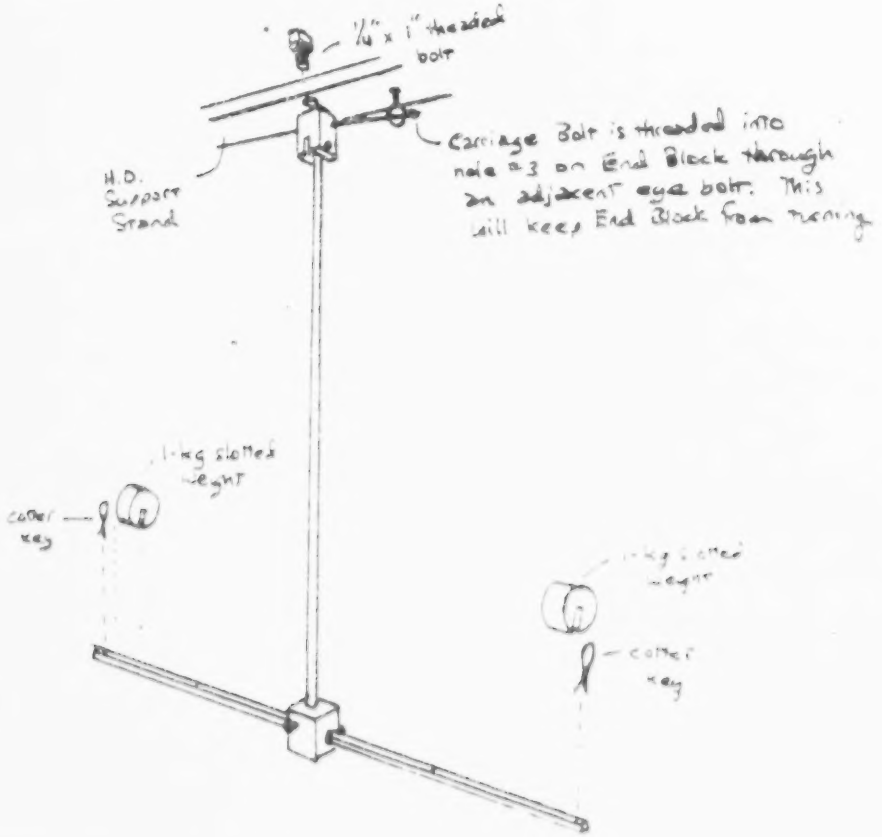


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

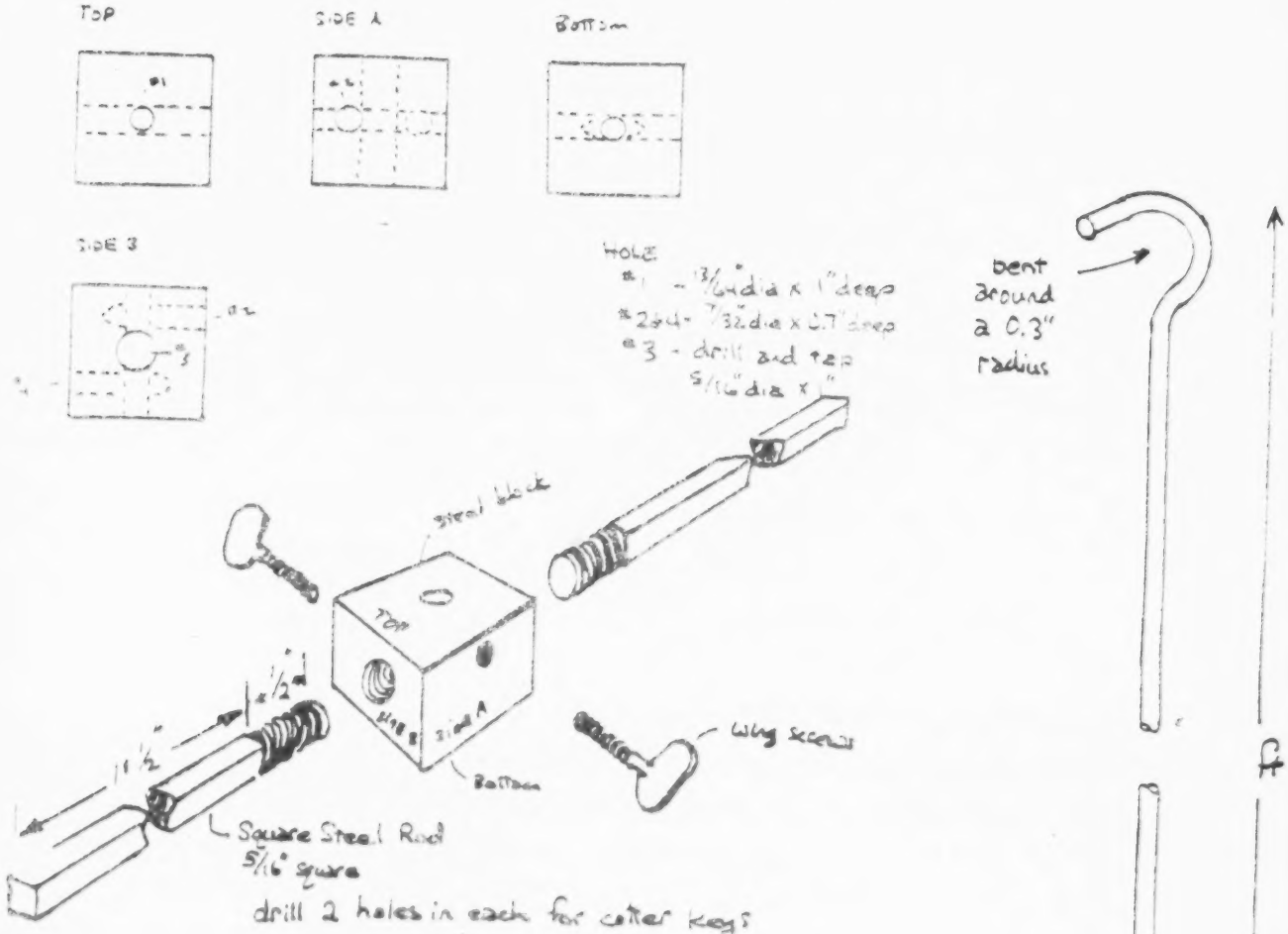
Item Name: Torsion Pendulum Assembly Item No. 205

MATERIALS

Steel rod, 24" long x 3/16" od
End block, steel 1" x 1" x 2"
Sliding steel block 1" x 1" x 1"
Two square steel rods, 5/16" square x 12" long
(With one end threaded on each rod.)
2 - 1-kg slotted weights
2 - wing screws 5/8" x 3/16" diam
Bolt - 1/4" x 1" long
Carriage bolt - 1/4" diam x 10" long

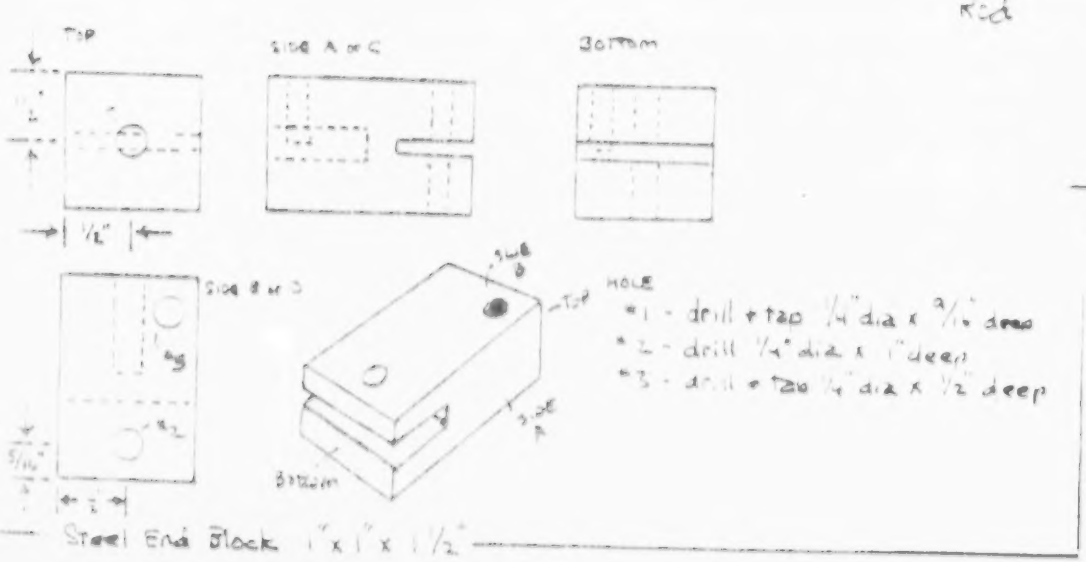

1/4" x 1" threaded bolt
H.D. Support Stand
Carriage Bolt is threaded into hole #3 on End Block through an adjacent eye bolt. This will keep End Block from moving
1-kg slotted weight
cotter key
1-kg slotted weight
cotter key

FABRICATION AND ASSEMBLY DETAILS ON BACK OF PAGE



Sliding Steel Block

Steel Torsion Rod


TOP
SIDE A or C
Bottom
1/2"
SIDE B or D
TOP
Bottom
HOLE
#1 - drill & tap 1/4" dia x 3/16" deep
#2 - drill 1/4" dia x 1" deep
#3 - drill & tap 1/4" dia x 1/2" deep
Steel End Block 1" x 1" x 1 1/2"

76-82

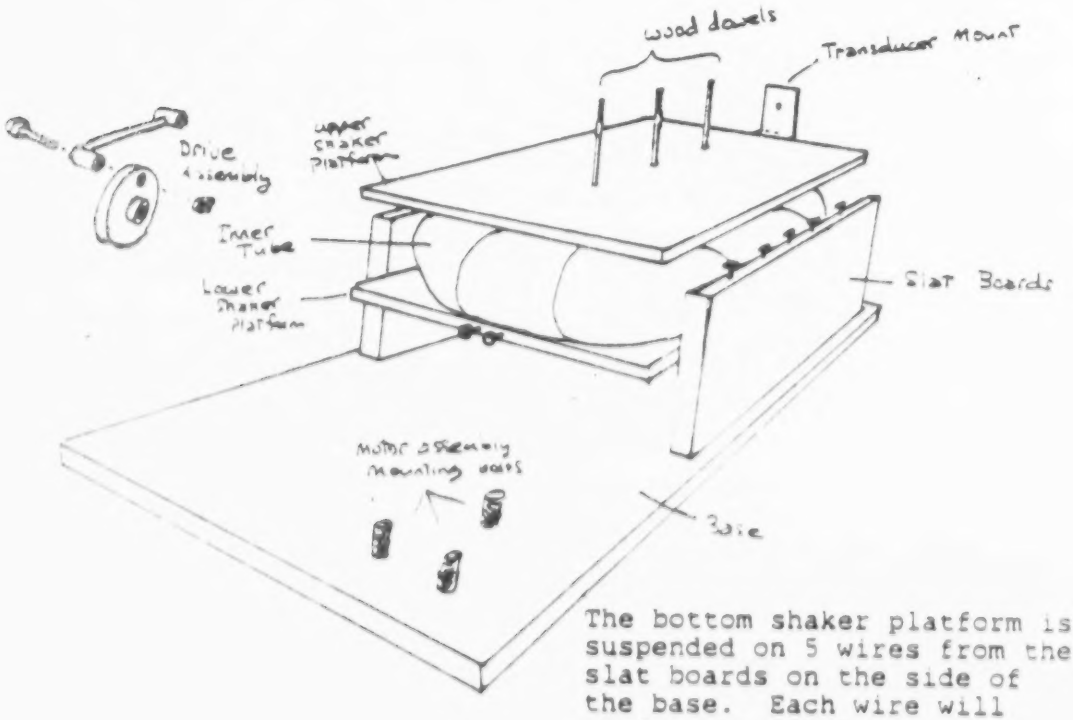
CORD/PT
Ross
3/01/86

Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Mechanical Shock Assembly Item No. 206

MATERIALS

Wood base, 24" x 18" x 5/8" plywood
2 - shaker platforms 12" x 12" x 1" plywood
Air inner tube (12" od max)
Steel wire, high tensile - 1 mm diam
2 - transducer mounts
Motor connector assembly
Mounting hardware
Wood dowel 5/16" diam x 14"
2 - wood slat boards 8" x 10" x 1"
Aluminum disk 2" diam x 3/16" thick with 3/4" x 9/16" diam hub
Brass tubes 3/16" id x 1/2" long
Brass rod 1/8" diam x 4 5/8" long



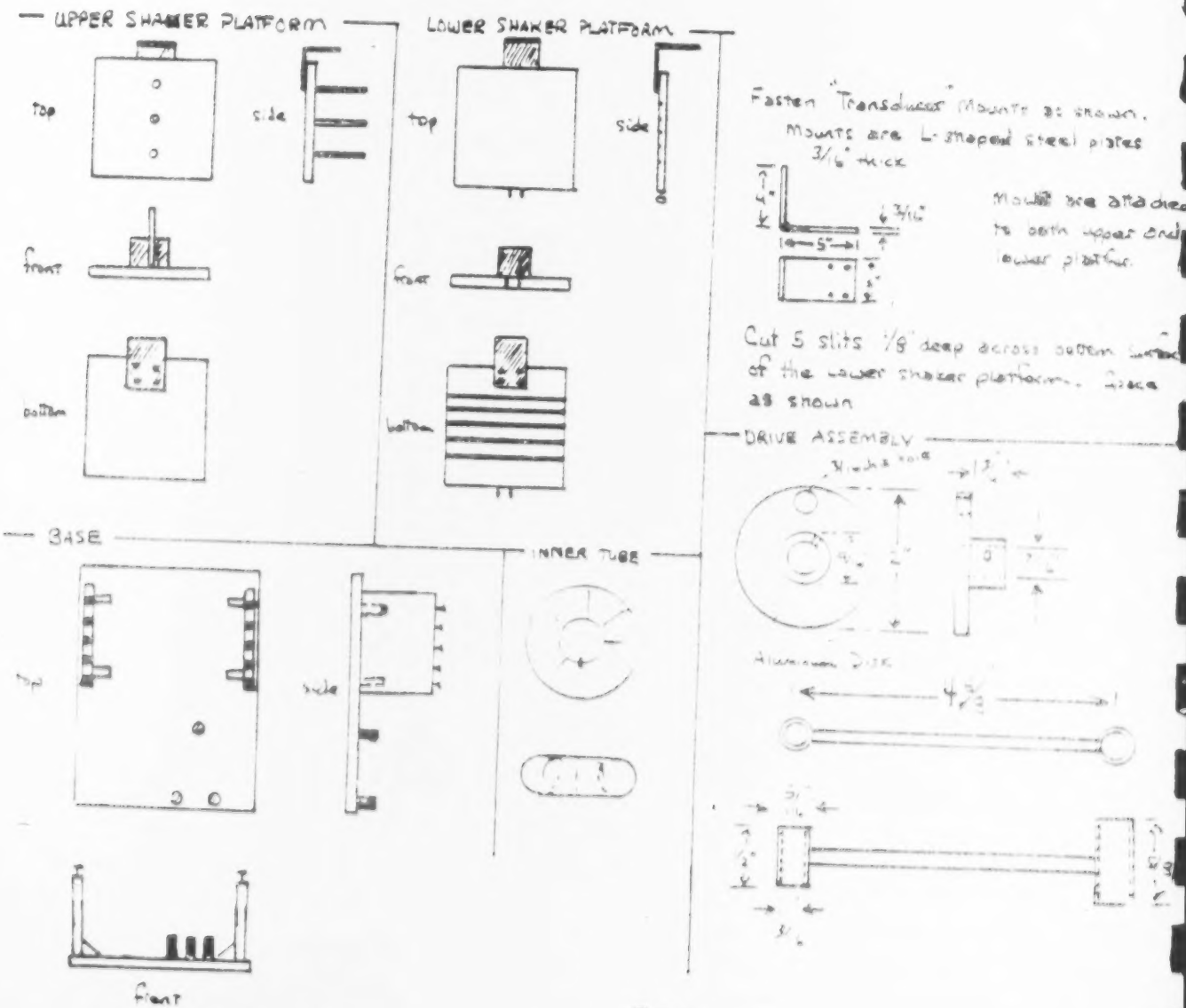
The bottom shaker platform is suspended on 5 wires from the slat boards on the side of the base. Each wire will need to be 25" long.

ADDITIONAL FABRICATION AND ASSEMBLY INFORMATION ON BACK OF PAGE

NOTE: An alternative way to induce vibrations is to use a cam drive.

The 2"-diam x 3/16" thick disk can act as the cam. The 3/4" x 9/16" diam hub can be mounted off-center. This hub should be mounted no more than 1/4" off-center. When the slug is mounted to the motor shaft and placed so that only the circumference of the disk is in contact with the bottom shaker platform a cam action occurs.

Be sure that the cam (off-center disk) contacts the bottom shaker platform where the axis of rotation (the motor shaft) and the circumference (the edge of the disk) are in closest approch.



CORD/PT
Ross
3/01/86

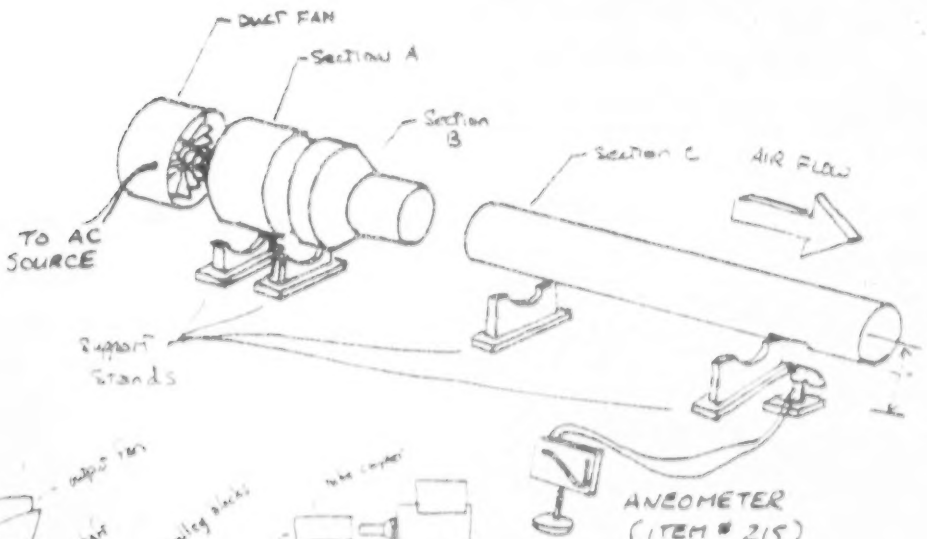
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

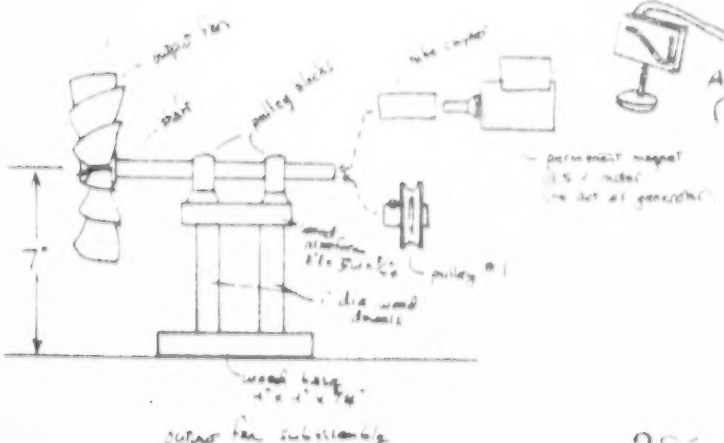
Item Name: Wind Generator Assembly Item No. 214

MATERIALS

Duct fan - 10" diam
Duct section A - 10" diam x 2' long
Duct section C - 8" diam x 5' long
Duct reducer (section B) - 10" to 8" diam
Duct tape
Support stands - made of wood
Bands
Output fan subassembly

Optional
38' x 1" id PVC pipe
PVC pipe cement





output fan subassembly

Apparatus must be built so center of flow is 7" above table top.

Output fan subassembly is constructed so axis of fan rotation is also 7" above table top.

Duct Fan and Output Fan Referenced
from W.W. Graingers, Inc.

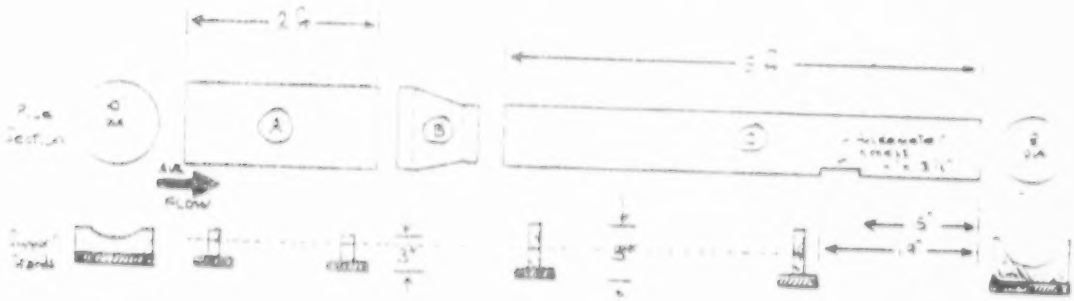
Duct fan - 10" diam with 1/100 hp motor 300 CFM at 0.73 A draw
Stock no. 2C222
Output fan - 7" diam with 5 wings of Al Stock no. 4C473

Output fan connecting shaft and pillow block referenced
from Stock Drive Products

1/4" diam shaft (0.2497" diam) 12" length, cat. no. 7X1-08120
Pulleys for round belts
#1 - 1/4" bore, 1" od with 5/8" hub diam,
cat. no. 6T10-1241008
#2 - 3/16" bore, 1" od with 5/8" hub diam,
cat. no. 6T10-1241006
Round belt
1/8" diam x 8" loop diam, cat. no. 6R11-04080
Two pulley blocks
1/4" bore with mounting holes 1 1/2" apart,
cat. no. 7Z6-F2208
Shaft collar
1/4" bore, 1/2" od, 9/32" wide with #10-24 x 1/8" set screw,
cat. n. 7C2-11608

Output generator
Small 1.5 VDC permanent magnet motor or a bicycle generator
coupled to output fan shaft.

NOTE: The 10" & 8" diam ducting is the most difficult thing to find and presents a hazard because of the sharpness of the edges. It would be possible to use PVC sewer pipe.

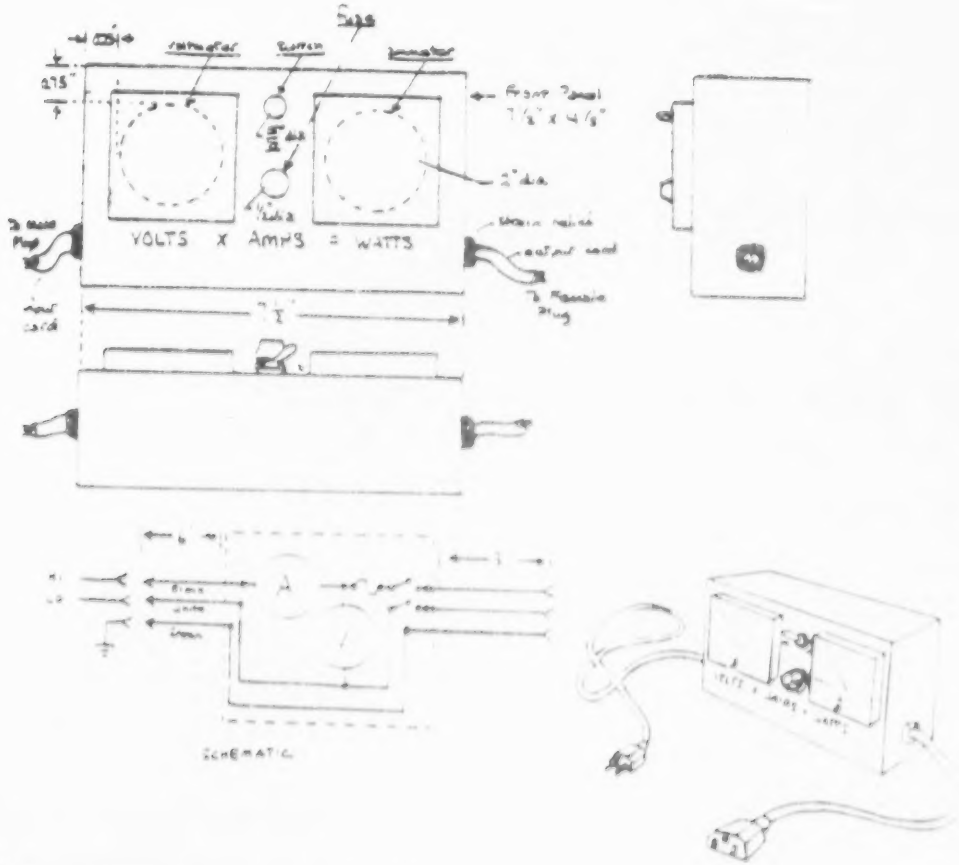


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: AC Power Measurement Module Item No. 227-ALT

MATERIALS

Panel meters
AC Ammeter 0-15 V AC
AC Voltmeter
Fuse holder with fuse
DPDT switch
Cabinet
Wire
Power cord



PARTS AND ESTIMATED COSTS OF MATERIALS ON BACK

All parts referenced to Allied Electronics Catalog #834

	Stock No.	Single Item Cost
Ammeter, AC 0-15 A ±5%	701-8508	$10.92
* Voltmeter, AC 0-150 V ±5%	701-8406	13.95
Switch, DPDT ON-OFF 15 A @ 125 V AC rating	757-4500 (mfr's type 7560KS)	4.60
Fuseholder	740R2006 (mfr's type HTA)	2.20
Fuse (311015/AGC)	603R0202	1.40/5
Cabient (7 1/2" x 4 1/3" x 2 1/4")	806-1599 (mfr's type 11591EOR)	7.90
Power cord 9" x 14 AWG, Type SJ	663-7086 (Belden #17629)	10.40
Strain reliefs - 2		
Total Materials Cost Estimate=		$52.00

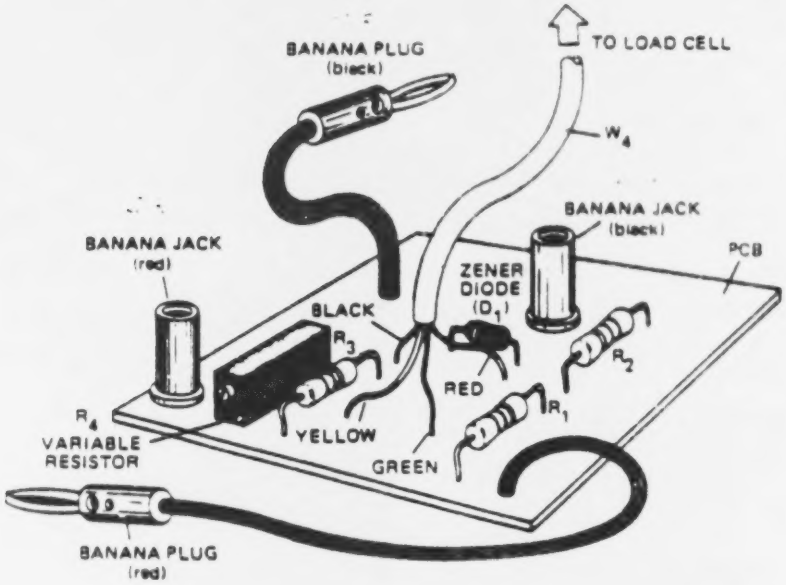
*model 850Z, 2 1/2" rectangular

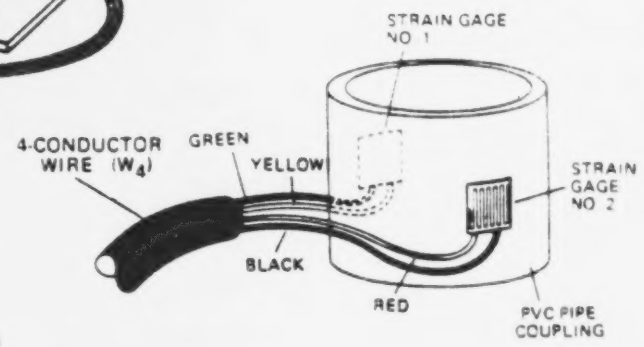
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Load Cell Assembly Item No. 228

MATERIALS

PVC slip-type pipe coupler, 2 3/8" long x 2" i.d.
Unbonded strain gages
Strain gage adhesive (cold cure)
Strain gage protective coating
Hook-up wire
Bridge output board
9-V battery connector





BRIDGE OUTPUT BOARD

R_1 = 330 ohms, 1/4 watt
R_2 = 15 ohms, 1/2 watt
R_3 = 1500 ohms, 1/2 watt
R_4 = 0 to 500 ohms, 3/4 watt
D_1 = Zener Diode 1n4739 (9.1 V)

ADDITIONAL INFORMATION AND DATA ON BACK OF PAGE

All strain gage materials are referenced to Omega Engineering, Inc. "Pressure and Strain Measurement Handbook and Encyclopedia" for 1985

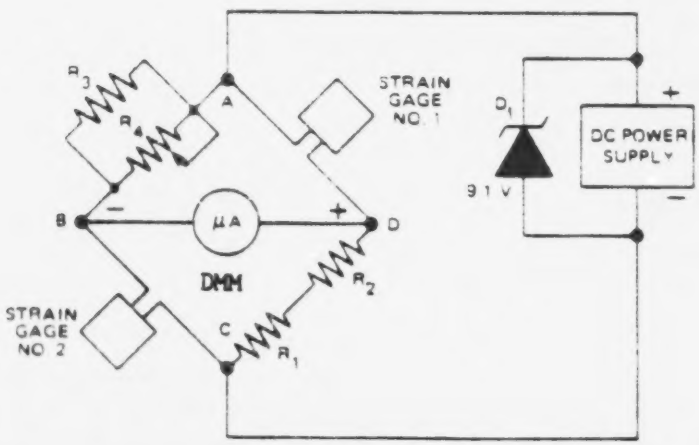
Strain gages, HBM 6/360 LY 11 10 for $46.00
Nominal Resistance = 350 ohms
Energizing Voltage = 15 VDC
GF = 2

Cold cure rapid adhesive, Z70 10 cc for $9.50
(enough for 250 gages)
Protective coat foil, ABM 75 11-205 x 100 mm pieces for $17.00
(enough for 200 gages)
Hook-up wire, TFCP-0 5-50 $11.00
(50 ft of 0.015" diam wire teflon coated)

NOTE:
Extensive educational materials on stress measurement technology is available from:

Measurements Group, Inc.
P.O. Box 27777
Raleigh, NC 27611

Student strain gages are also available--comparable to those listed above,
Model # EA-06-240LZ-120 for $10.00 per package of 10.
Nominal Resistance = 120 ohms, intended for mount to steel.



CORL
ROSS
3/01 86

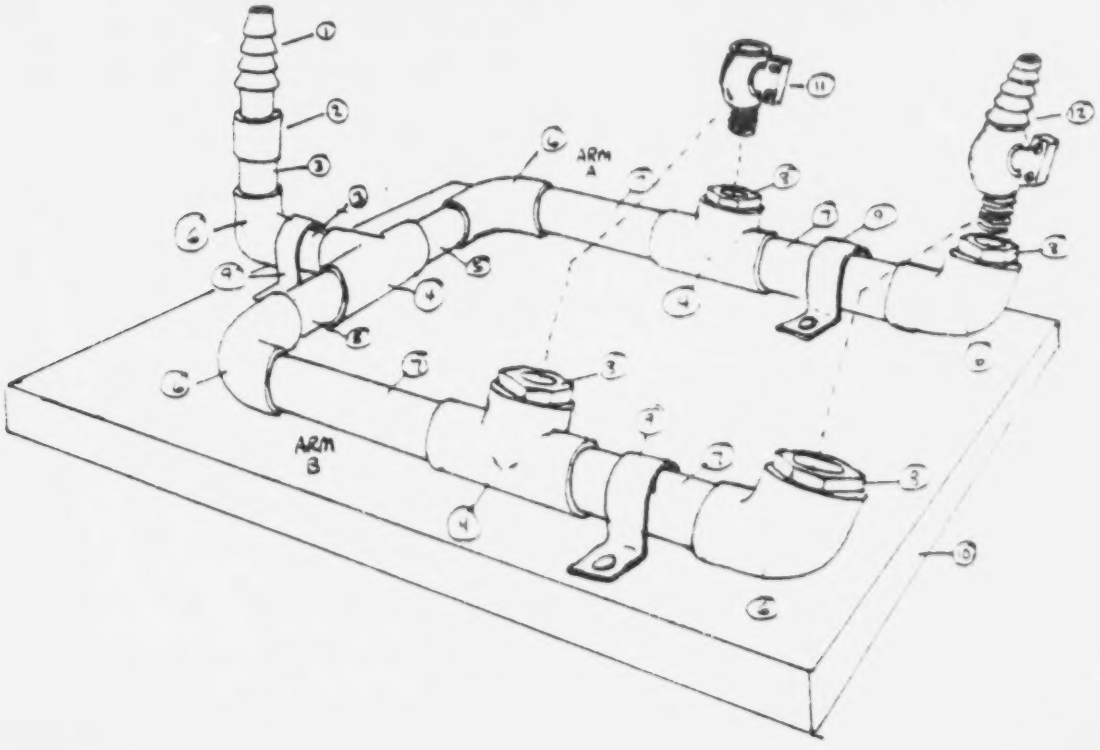
Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Pressure Manifold Assembly Item No. 231

MATERIALS:

1 - Plywood board (10) 18" x 8" x 3/8"
1 - PVC adaptor (1) Tubing to 1/4" id pipe to NPT
1 - PVC adaptor (2) 1/4" female NPT to slip
3 - PVC pipe tees, 1/4" id, slip type (4)
3 - PVC elbows, 90 , 1/4" id, slip type (6)
4 - PVC adaptors, 1/4" id slip to female NPT (8)
3 - Pipe hold-down clamps 9
2 - Brass cutoff valves 11
2 - Brass cutoff valves with nipple (12)

PVC pipe sections - 1/4" id
2 - (3) 2"
2 - (5) 3"
4 - (7) 4"

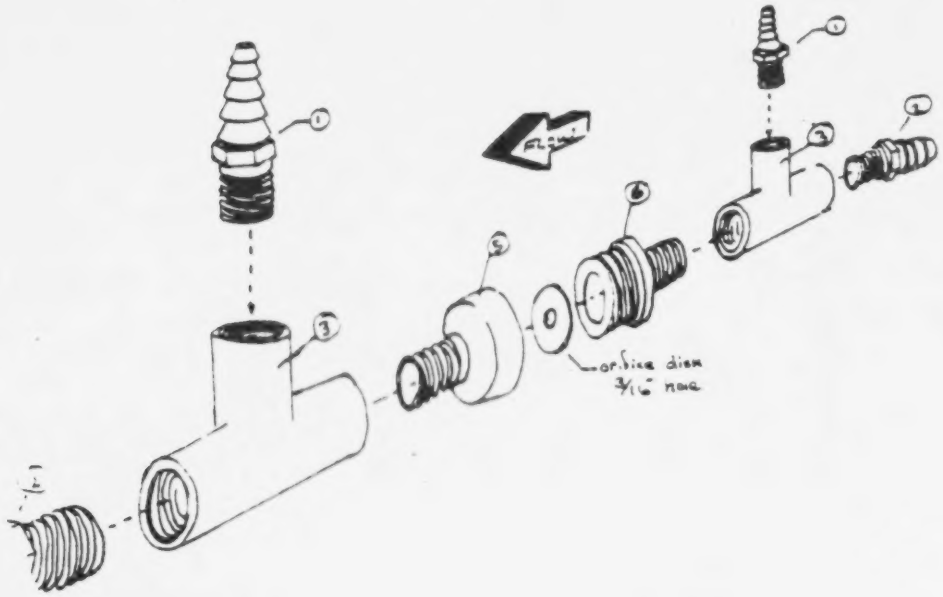


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Liquid Flow Orifice Item No. 233

MATERIALS.

Adaptors NPT to nipple for tubing (1)
Adaptors NPt to nipple for hoses (2)
PVC tees NPT type 3/8" - 1/2" id (3)
Orifice disk, copper 1 1/4" od x 1/16" t with 3/16" id hole
Male-female threaded coupler (5)
Male-male threaded coupler (6)

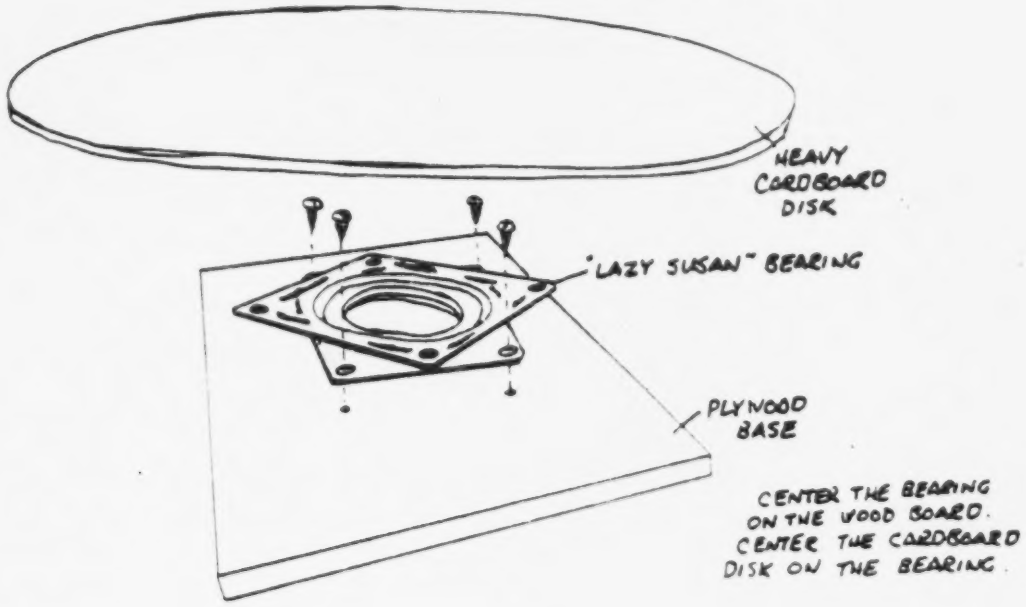


Principles of Technology
DESIGN NOTES ON SPECIAL EQUIPMENT

Item Name: Lazy Susan Optics Table Item No. 240

MATERIALS

"Lazy Susan" 3" diam bearing
Wood base - plywood 1" x 1" x 5/8"
Heavy cardboard disk 17 1/2" diam with white matte finish
4 - wood screws
Adhesive


HEAVY CARDBOARD DISK
"LAZY SUSAN" BEARING
PLYWOOD BASE
CENTER THE BEARING ON THE WOOD BOARD. CENTER THE CARDBOARD DISK ON THE BEARING.

Center the bearing on the wood board. Center the cardboard disk on the bearing.

"Lazy Susan" is available in 3", 4", 6 1/8", and 12" sizes from Edmund Scientific Co with part no. H40,600 (3" size)

PRINCIPLES OF TECHNOLOGY: COST COMPARISON WORKSHEET

ITEM NO.	QUANTITY	VENDOR _____ CAT. NO	UNIT PRICE	TOTAL PRICE	VENDOR _____ CAT. NO.	UNIT PRICE	TOTAL PRICE	NOTES OR COMMENTS

SCIENTIFIC LABS, INC.

1-800-654-9750

INTRODUCTION TO TECHNOLOGY

20 MODULES, 40 DISKETTES COVERING UNITS 1-7 OF PRINCIPLES OF TECHNOLOGY

$2,695.00

The enclosed correlation is subject to change until the finished product is released March 30, 1987.

P. O. BOX 803788 HOUSTON, TEXAS 77280 (713) 464-6068

UNIT 1 FORCE

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	3-10	2-42	Unit 1, Subunit 1	FORCE
Fluid	10-13	43-59	Unit 1, Subunit 2	PRESSURE DIFFERENCE
Electrical	13-15	60-92	Unit 1, Subunit 3	POTENTIAL DIFFERENCE
Thermal	15-17	93-99	Unit 1, Subunit 4	TEMPERATURE DIFFERENCE

UNIT 2 WORK

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	33-37	105-122	Unit 2, Subunit 1	WORK: AS DISPLACEMENT UNDER ACTION OF FORCE
Fluid	37-39	123-128	Unit 2, Subunit 2	WORK: AS FLUID VOLUME DISPLACEMENT
Electrical	39-41	129-136	Unit 2, Subunit 3	WORK: AS DISPLACEMENT
Thermal	41-47	137-150	No Related Material	No Related Material

UNIT 3 RATE

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	59-69	155-203	Unit 3, Subunit 1	SPEED
Fluid	69-71	204-211	Unit 3, Subunit 2	FLOW RATE
Electrical	71-72	212-229	Unit 3, Subunit 3	CURRENT
Thermal	72-73	230-246	Unit 3, Subunit 4	HEAT FLOW RATE

UNIT 4 MOMENTUM

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	84-95	250-284		
Fluid	96	285-293	THIS TOPIC IS NOT COVERED IN PRINCIPLES OF TECHNOLOGY	
Electrical	---	294-296		

UNIT 5 RESISTANCE

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	105-110	301-311	Unit 4, Subunit 1	FRICTION AND DRAG
Fluid	110-115	312-337	Unit 4, Subunit 2	FLUID RESISTANCE
Electrical	115-117	338-382	Unit 4, Subunit 3	ELECTRICAL RESISTANCE
Thermal	117-120	383-393	Unit 4, Subunit 4	THERMAL RESISTANCE

UNIT 6 POWER

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	137-141	401-424	Unit 6, Subunit 1	POWER IN MECHANICAL SYSTEMS
Fluid	142-143	425-459	Unit 6, Subunit 2	POWER IN FLUID SYSTEM
Electrical	143-145	460-478	Unit 6, Subunit 3	ELECTRICAL POWER
Thermal	146	479-487	Unit 6, Subunit 4	THERMAL POWER

UNIT 7 POTENTIAL AND KINETIC ENERGY

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	156-163	494-500	Unit 5, Subunit 1	ENERGY IN MECHANICAL SYSTEMS
Fluid	163-168	501-508	Unit 5, Subunit 2	ENERGY IN FLUID SYSTEMS
Electrical	168-169	509-528	Unit 5, Subunit 3	ELECTRICAL ENERGY
Thermal	170	529-537	Unit 5, Subunit4	HEAT

UNIT 8 FORCE TRANSFORMERS

SUBUNIT TITLE	UTC STUDENT TEXT PG. NO.*	APP. PHYSICS TEXT PG. NO.**	PRINCIPLES OF TECH. VIDEO SECTION	INTRODUCTION TO TECHNOLOGY MODULE
Mechanical	183-194	NOT COVERED	Unit 7, Subunit 1 & 2	
Fluid	195-196	NOT COVERED	Unit 7, Subunit 3	
Electrical	196-199	NOT COVERED	Unit 7, Subunit 4	CORRELATION TO BE DETERMINED

*Unified Technical Concepts - Physics For Technicians

**Applied Physics for Technicians: A Unified Approach

INTRODUCTION OT TECHNOLOGY SYSTEM CONFIGURATION
CONSISTS OF THE FOLLOWING HARDWARE

COMPUTER: 384K RAM
two 360 KB diskette drive
one serial RS-232C port
one parallel port
keyboard with numerical pad and 12 programmable function keys.
Calender/Clock
CPU to Run at a minimum of 8MHz
two 7220 Co-processors
Color Graphic Card
MS-DOS Operating System and GW-Basic

MONITOR: 14" Color, Tilt and Swivel, 640 x 400 High resolution

TO BE NEC APC III H102C

DIGITIZER: Mouse - Microsoft Serial Mouse

PRINTER: Dot Matrix - 120 cps, 80 col. w/cable

TO BE STAR NX-10

SOFTWARE: Introduction to Technology
20 modules, 40 disketts covering Units 1-7
of Princinles of Technology and UTC Physics.

PRICE: $4,895.00

UNIT III
PHYSICS

UNIT OBJECTIVES

After completion of this unit the student will be able to solve problems in vector mechanics, wave motion, sound waves, and refraction of light. An understanding of mechanical linkage, electromagnetic control systems, and heat will also be gained. The student will demonstrate this knowledge by successfully completing all assignments and tests with a minimum score of 75 percent.

SPECIFIC OBJECTIVES

After completing this unit the student will be able to:

1. State the properties of matter.
2. Solve problems in vector mechanics.
3. Name the various types of linkages.
4. Demonstrate the effects of rate through the application of force and work.
5. Describe the transducers used in the measurement of temperature, flow rate, and acoustical energy.
6. Describe the characteristics of a sound wave.
7. State the theory of light.
8. Identify the various precision measurements as used in industry.

UNIT III--PHYSICS

Instructional Lesson 1--Force
Task Assignment 1--Demonstrate the Applications and Effects of Force Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 1A--Demonstrate the Applications and Effects of Force Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 1B--Demonstrate the Applications and Effects of Force Through Laboratory Exercises Using Electrical Energy Systems
Task Assignment 1C--Demonstrate the Applications and Effects of Force Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 2--Work
Task Assignment 2--Demonstrate the Applications and Effects of Work Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 2A--Demonstrate the Applications and Effects of Work Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 2B--Demonstrate the Applications and Effects of Work Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 3--Rate
Task Assignment 3--Demonstrate the Applications and Effects of Rate Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 3A--Demonstrate the Applications and Effects of Rate Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 3B--Demonstrate the Applications and Effects of Rate Through Laboratory Exercises Using Electrical Energy Systems
Task Assignment 3C--Demonstrate the Applications and Effects of Rate Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 4--Momentum
Task Assignment 4--Demonstrate the Applications and Effects of Momentum Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 4A--Demonstrate the Applications and Effects of Momentum Through Laboratory Exercises Using Fluidal Energy Systems

Instructional Lesson 5--Resistance
Task Assignment 5--Demonstrate the Applications and Effects of Resistance Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 5A--Demonstrate the Applications and Effects of Resistance Through Laboratory Exercises Using Fluidal Energy Systems

UNIT III--continued

Task Assignment 5B--Demonstrate the Applications and Effects of Resistance Through Laboratory Exercises Using Electrical Energy Systems

Task Assignment 5C--Demonstrate the Applications and Effects of Resistance Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 6--Power

Task Assignment 6--Demonstrate the Applications and Effects of Power Through Laboratory Exercises Using Mechanical Energy Systems

Task Assignment 6A--Demonstrate the Applications and Effects of Power Through Laboratory Exercises Using Fluidal Energy Systems

Task Assignment 6B--Demonstrate the Applications and Effects of Power Through Laboratory Exercises Using Electrical Energy Systems

Task Assignment 6C--Demonstrate the Applications and Effects of Power Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 7--Potential and Kinetic Energy

Task Assignment 7--Demonstrate the Applications and Effects of Potential and Kinetic Energy Through Laboratory Exercises Using Mechanical Energy Systems

Task Assignment 7A--Demonstrate the Applications and Effects of Potential and Kinetic Energy Through Laboratory Exercises Using Fluidal Energy Systems

Task Assignment 7B--Demonstrate the Applications and Effects of Potential and Kinetic Energy Through Laboratory Exercises Using Electrical Energy Systems

Task Assignment 7C--Demonstrate the Applications and Effects of Potential and Kinetic Energy Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 8--Force Transformers

Task Assignment 8--Demonstrate the Applications and Effects of Force Transformers Through Laboratory Exercises Using Mechanical Energy Systems

Task Assignment 8A--Demonstrate the Applications and Effects of Force Transformers Through Laboratory Exercises Using Fluidal Energy Systems

Task Assignment 8B--Demonstrate the Applications and Effects of Force Transformers Through Laboratory Exercises Using Electrical Energy Systems

Instructional Lesson 9--Energy Convertors

Task Assignment 9--Demonstrate the Applications and Effects of Energy Convertors Through Laboratory Exercises Using Fluidal Energy Systems

Task Assignment 9A--Demonstrate the Applications and Effects of Energy Convertors Through Laboratory Exercises Using Electrical Energy Systems

UNIT III--continued

Task Assignment 9B--Demonstrate the applications and Effects of energy Convertors Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 10--Transducers
Task Assignment 10--Demonstrate the Applications and Effects of Transducers Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 10A--Demonstrate the Applications and Effects of Transducers Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 10B--Demonstrate the Applications and Effects of Transducers Through Laboratory Exercises Using Electrical Energy Systems
Task Assignment 10C--Demonstrate the Applications and Effects of Transducers Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 11--Vibrations and Waves
Task Assignment 11--Demonstrate the Application and Effects of Vibrations and Waves Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 11A--Demonstrate the Applications and Effects of Vibrations and Waves Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 11B--Demonstrate the Applications and Effects of Vibrations and Waves Through Laboratory Exercises Using Electrical Energy Systems

Instructional Lesson 12--Time Constants
Task Assignment 12--Demonstrate the Applications and Effects of Time Constants Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 12A--Demonstrate the Applications and Effects of Time Constants Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 12B--Demonstrate the Applications and Effects of Time Constants Through Laboratory Exercises Using Electrical Energy Systems
Task Assignment 12C--Demonstrate the Applications and Effects of Time Constants Through Laboratory Exercises Using Thermal Energy Systems

Instructional Lesson 13--Radiation
Task Assignment 13--Demonstrate the Applications and Effects of Radiation Through Laboratory Exercises Using Mechanical Energy Systems
Task Assignment 13A--Demonstrate the Applications and Effects of Radiation Through Laboratory Exercises Using Fluidal Energy Systems
Task Assignment 13B--Demonstrate the Applications and Effects of Radiation Through Laboratory Exercises Using Electrical Energy Systems

UNIT III--continued

Task Assignment 13C--Demonstrate the Applications and Effects of Radiation Through Laboratory Exercises Using Thermal Energy Systems

SUGGESTED REFERENCES

Unified Technical Concepts Text ISBN-1-55502-161-1. 2nd ed. Waco, Texas: The Center for Occupational Research and Development (CORD), 1984.

Unified Technical Concepts Applications Volume I Lab Manual ISBN-1-55502-162-X. Waco, Texas: The Center for Occupational Research and Development (CORD), 1983.

Unified Technical Concepts Applications Volume II Lab Manual ISBN-1-55502-163-8. Waco, Texas: The Center for Occupational Research and Development (CORD), 1983.

Harris, N. C., and E. M. Hemmerling. Introductory Applied Physics. 4th ed. Manchester, MO: Gregg/McGraw-Hill Book Company, 1980.

Beiser, Arthur. Modern Technical Physics. 3rd ed. Menlo Park, CA: The Benjamin/Cummings Publishing Co., Inc., 1983.

APPENDIX F

Project Fairs

If a student is taking PT for a science credit, it is suggested that a science project be completed. (See science fair rules.)

Students taking PT for credit in industrial arts may complete a project for the industrial arts fair (See industrial arts fair rules.)

A MESSAGE

TO THE

INDUSTRIAL ARTS TEACHERS AND STUDENTS

The first Industrial Arts Students Fair in Louisiana was held on the campus of Northwestern State University of Natchitoches in 1947. This event continued to serve Industrial Arts throughout the state for 20 years. Continued growth of Industrial Arts programs and increased student enrollment brought such pressures on the Northwestern State University Fair that it was deemed necessary to expand the program. In 1967 a committee was formed to study the feasibility of dividing the state into three geographic areas and establishing a fair in each area. Concurrently, a proposal was drafted and presented to a funding agency requesting financial support. The proposal suggested a three-year trial period terminating with a "State Final Fair" to be held in conjunction with the annual conference of the Louisiana Association of Industrial Arts Clubs.

After two years of operation on this basis, it was decided the Industrial Arts program in the state could justify a further geographic breakdown and that the fair program was in need of more counseling. It was at this time that the name was changed from "Student Craftsman's Fair" to "Industrial Arts Students' Fair." Guidance and administration of the program were provided through the establishment of an Advisory Council in 1970. The Advisory Council later became the Louisiana Industrial Arts Student Fair (LIASF) Executive Committee. This committee is composed of one representative from each of the four universities that host an area fair, a teacher representative from each of these areas, the Industrial Arts State Advisor, and the AIASA of Louisiana Executive Secretary. The LIASF Executive Committee is charged with the responsibility of setting policy, establishing rules and regulations, and general administration of both area and state fairs. Because of the revised Industrial Arts curriculum that was implemented in the 1984-85 school year, the Executive Committee found it necessary to revise extensively this handbook so that it would be in compliance with the new curriculum standards.

The primary purpose of the Fair is to promote high standards of craftsmanship and scholarship through competition in the various instructional areas and activities related to Industrial Arts. Benefits to the student include increased motivation, intellectual growth, a better understanding of industry and technology, fellowship with other students, visits to university campuses, and participation in leadership programs at the State Conference.

Any Louisiana Industrial Arts student who meets the requirements stated in the regulations governing the fair may participate. However, maximal benefit will be obtained by participating in the fair as a member of an organized Industrial Arts club affiliated with the Louisiana Industrial Arts Student Association.

Many people have worked to make the fair a worthwhile experience. We encourage you, the Industrial Arts teachers and students of Louisiana, to take full advantage of its benefits. Only through your active support and participation can it accomplish its purposes.

Louisiana Industrial Arts Student Fair Executive Committee

GENERAL INFORMATION

Area Fairs

The Louisiana Industrial Arts Student Area Fairs are conducted during the month of April. These Fairs are held at the following Universities:

Area	Unit	Area Advisor
I	Northwestern State University	Dr. Thomas Eppler
II	University of Southwestern Louisiana	Mr. Mickey Hebert
III	Louisiana State University	Dr. Vincent Kuetemeyer
IV	Southeastern Louisiana University	Dr. Jerry Parish

State Fair

Student winners (1st, 2nd, 3rd, and 4th) in the Area Fairs are eligible to compete in the State finals which will be held in the latter part of April or first week of May. The location of LIASF (State Level) will be in Baton Rouge unless otherwise notified.

LIASF Competition

All competition, unless otherwise noted herein, will be judged on the premise that what a student knows about the area that is entered is equally as important as what the student can do in the area. Winning in an area such as Basic Woods (BW) will therefore require a good understanding of the material covered in the state curriculum guide as well as demonstrated competencies in as many different operations as feasibly possible. In judging entries (if all other aspects of making the projects are equal) the better entry is the one that uses the most processes as recommended or covered in the state curriculum guide. "Other aspects" include excellence in design, utility, craftsmanship, and ingenuity. Winners will be selected by equally (50-50) evaluating test and project scores at the Area and State Fairs. The decisions of the judges are final. It is hoped that the teachers will stress the objectives of the Fair program and place less emphasis on winning. Teaching just for the Fair is not educationally sound. It is hoped rather that the Fair will be but an additional "tool" which a dedicated teacher will use to motivate and teach. If the teachers will use the Fair in this way, all the participants will be winners!

Annual Louisiana Industrial Arts Conference

The state finals of the LIASF will be held in conjunction with the annual AIASA of Louisiana conference.

Registration -- Area Fair

A sample registration form is shown in the appendix. Each spring the four area Fair directors will mail out a similar form to the teachers in their area. A letter will be included to give pertinent information such as when, where, time, and rule changes for the Fair.

Registration -- State Fair

Winning at Area Fair automatically enters the student in the State Fair.

Area Fair Awards

First, second, third, and fourth place awards will be presented to the students earning the most points in his/her classification as determined by the combined project and test scores. The judges and/or fair director have the responsibility to deny giving awards if there are no meritorious entries.

Honorable mention awards are given to deserving students in each classification.

Certificates of Recognition are awarded to all students who participate in the Area Fair.

State Fair Awards

First, second, third, and fourth place awards for each classification entered will be given to the students who have accumulated the most points overall. (Includes both written examination and project)

GENERAL RULES

1. Entrants may be any student enrolled in an Industrial Arts class in a Louisiana private, public, or parochial junior or senior high school.

2. Students participating in Industrial Arts and vocational classes in the same area concurrently will not be eligible to enter in that area.

3. There is an entry fee to participate in the Fair. The amount each year will be indicated in the Fair letter sent out in the spring to the teachers. One fee is charged each entrant even if more than one classification is entered.

4. Whether they have a project or not, all students who go to an area Fair will register and take a test--either the specific area test or the general test.

5. All projects must be made in school under the supervision of an Industrial Arts instructor.

6. Projects must have been started and completed in the current school year.

7. Projects made from commercial kits are not eligible. Component parts should be made by the student whenever reasonably possible and judges will evaluate accordingly.

8. The cost of transporting the project to and from the Fair must be borne by the student, school, instructor, or some agency not associated with the Fair. The student should bring all necessary accessories to display his/her work. (Extension cords, AV equipment, etc.)

9. The judging will be done by Industrial Arts teachers and other qualified persons such as representatives of industry. The project scores awarded by the judges are final.

10. As many as three projects may be used to represent a student's entry in each classification unless otherwise noted in the Fair rules governing each classification. A student may enter three classifications.

11. In order for their students to be eligible to participate in the Fair, teachers must register them by the indicated date on the registration form. This registration form and other information concerning the Fair is mailed to the teachers each Spring. If you have not received the Fair letter by the first of April, contact your Fair director immediately.

12. To be eligible, all entries must be delivered to the Fair site by the time indicated in the Fair letter on the day of the Fair.

13. Teachers are requested to send in the appropriate fees with their registration forms. (No cash please. Make checks or money orders payable as directed in the Fair letter.)

14. Judging will start immediately after the check-in deadline has passed and the Fair officials are caught up in the processing of entrants. No one will be checked in after the judging starts.

15. All projects must be the work of one student, except for group projects or where otherwise noted. Group projects are to be placed in a separate classification.

16. Student projects can only be entered in the classification which represents the course in which enrolled. For example, the fair classification "Architectural Drafting" can only be entered by students enrolled in the State Department of Education approved course (Bulletin 741) Architectural Drafting. The only exceptions to this rule are the fair classifications "Group Projects" and "Open."

17. Teachers should read the classification descriptions very carefully prior to assigning a classification to a project. The judge will not re-classify a project which entered a classification above its level; projects below the level allowed will be disqualified. If a question of classification arises, one should contact the Area Fair Director for clarification.

18. The material covered in the <u>minimum</u> standards of a particular course are to be the principle areas emphasis in producing a project to be judged in the respective classification at the Fair. A project which utilizes few basic concepts or processes and stresses concepts and processes mostly beyond the normal expectancy for the course will be low rated by the judges. An example would be having inking drawings in the "Basic Technical Drafting" display when that area stresses mostly (or solely) pencil work. This entry would receive lower marks for this improper emphasis.

19. In determining winners, the project and test are considered of equal value and therefore the total score is on a 50-50 basis. In the event of a total score tie, the winner will be determined by who has the highest project score. In the event they are still tied, the judges will be ask to re-evaluate the two projects in question. If a tie still exists, duplicate awards will be made.

20. A dimensioned sketch (8½ x 11) or drawing and a list of operations used is required to accompany each project or entry where applicable. No sketch is required for graphic arts. No list of operations is required for technical drafting.

21. There will not necessarily be an award given in each classification; the judges will decide which awards are to be given in the various classifications.

22. It is discourteous for teachers and students to leave the awards assembly before it is over. Everyone in attendance at the beginning is expected to stay to the end of the assembly.

HIGH SCHOOL FAIR CLASSIFICATIONS

GRADES NINE THROUGH TWELVE

Classification	Designation
General Industrial Arts	GIA
Basic Technical Drafting	BTD
Advanced Technical Drafting	ATD
Architectural Drafting	AD
Basic Woodworking	BW
Advanced Woodworking	AW
Construction	CST
Basic Electricity/Electronics	BEE
Advanced Electricity	AEY
Advanced Electronics	AES
Basic Metals	BM
Advanced Metals	AM
Basic Welding	W
Power and Energy	PE
Power Mechanics	PM
Basic Graphic Arts	BGA
Advanced Graphic Arts	AGA
Basic Plastics	BP
Basic Recreational Crafts	BRC
Advanced Recreational Crafts	ARC
Group Projects	GP
Basic Open	BO
Advanced Open	AO

HIGH SCHOOL CLASSIFICATIONS

Entry Requirements

GIA (General Industrial Arts) - This Fair classification is to represent the "survey" nature of the General Industrial Arts course. Judges will rate higher those projects which use several areas of industrial arts as well as a variety of operations. This is not to say that quality is unimportant, but it may suffer somewhat to get the broad base exposure expected.

Each student may enter as many as three projects. All of these will be given one total score. No more than twelve weeks should be spent on each project. Combination projects are allowed.

At least three of the following areas must be represented in an entry: wood, metal, electricity/electronics, power/energy, graphics, plastics or drafting.

BTD (Basic Technical Drafting) - For students who are in their first drafting course. Entrants are to submit four 9 x 12 drawings displayed on one 18 x 24 sheet. All drawings are to be pencil, lettered, and dimensioned. The subjects of the four drawings are to be different; one each from the areas of orthographic projection, pictorials, sections, and auxiliaries.

NOTE: All drawing problems must have names and schools covered when registering.

ATD (Advanced Technical Drafting) - For students who are in their second drafting course. Students are to develop a set of working drawings which are to include an assembly drawing and a detailed drawing of each part in the assembly, excluding standard parts. In addition one drawing must be prepared from one of the following types: (1) exploded pictorial of the above assembly drawing, (2) structural drawing, (3) electrical drawing, or (4) piping drawing.

AD (Architectural Drafting) - Any project such as a residence or small commercial building may be entered. A complete set of working drawings in pencil or ink must be submitted. Sheet size should be approximately 24" x 36" and should not be rolled or mounted on cardboard or other material. The entry must include items 1 - 5 below.

1. Floor plan
2. Foundation plan
3. Four elevations
4. Plot plan
5. Details to include:
   - A. Labeled foundations
   - B. Labeled typical wall section
   - C. Labeled cornice
   - D. Labeled bearing partitions
   - E. Other details as required by the project
6. Optional
   - A. Electrical
   - B. Heat and air conditioning plans (oneline drawings)
   - C. Plumbing (on commercial drawings)
   - D. Other, as desired

BW (Basic Woodworking) - For students who are in their first woodworking course. Architectural models and upholstered projects should not be entered here but in the Open classification.

AW (Advanced Woodworking) - For students who are in their second woodworking course.

CST (Construction) - Students will submit such items as construction contracts, materials list and cost estimates, time schedules for construction, working drawings including plot plans, and/or framing structure. Judges will be looking for evidence of a broad based construction experience.

BEE (Basic Electricity/Electronics) - For students who are in the basic electricity/electronics course. Projects should represent theory and operations taught at this level. No commercial kits are allowed.

AEY (Advanced Electricity) - Projects or displays in such areas as motor operation, generators, control devices, and house wiring may be entered.

AES (Advanced Electronics) - Working projects or displays in any area of electronics may be entered. Appropriate descriptions of projects should accompany each project (what is it - how does it work?). No commercial kits are allowed.

BM (Basic Metals) - For students who are in their first metals course. It is preferable that several areas of metals be represented in the project.

AM (Advanced Metals) - For students who are in their second year of metals.

W (Welding) - For students who are in their first welding course. Welds will be the first consideration of the judges. Second consideration will be given to the overall appearance including squareness, fit, function, and finish. Grind welds only when necessary.

PE (Power/Energy) - A project might be any device or means of developing, utilizing, or demonstrating the several kinds of power and energy (internal combustion, fluids, nuclear, etc.).

PM (Power Mechanics) - Entries might be models or displays in any area of power mechanics.

BGA (Basic Graphic Arts) - This entry would preferably be a group of well executed specimens in the area; properly displayed on poster board or other medium.

AGA (Advanced Graphic Arts) - For students who are in their second graphic arts course. Entry should be a display of work done in the area.

BP (Basic Plastics) - Forming and production processes will be judged in this area.

BRC (Basic Recreational Crafts) - Projects should encompass planning, designing, and constructing crafts in such as the following areas: metals, ceramics, leather, and plastics.

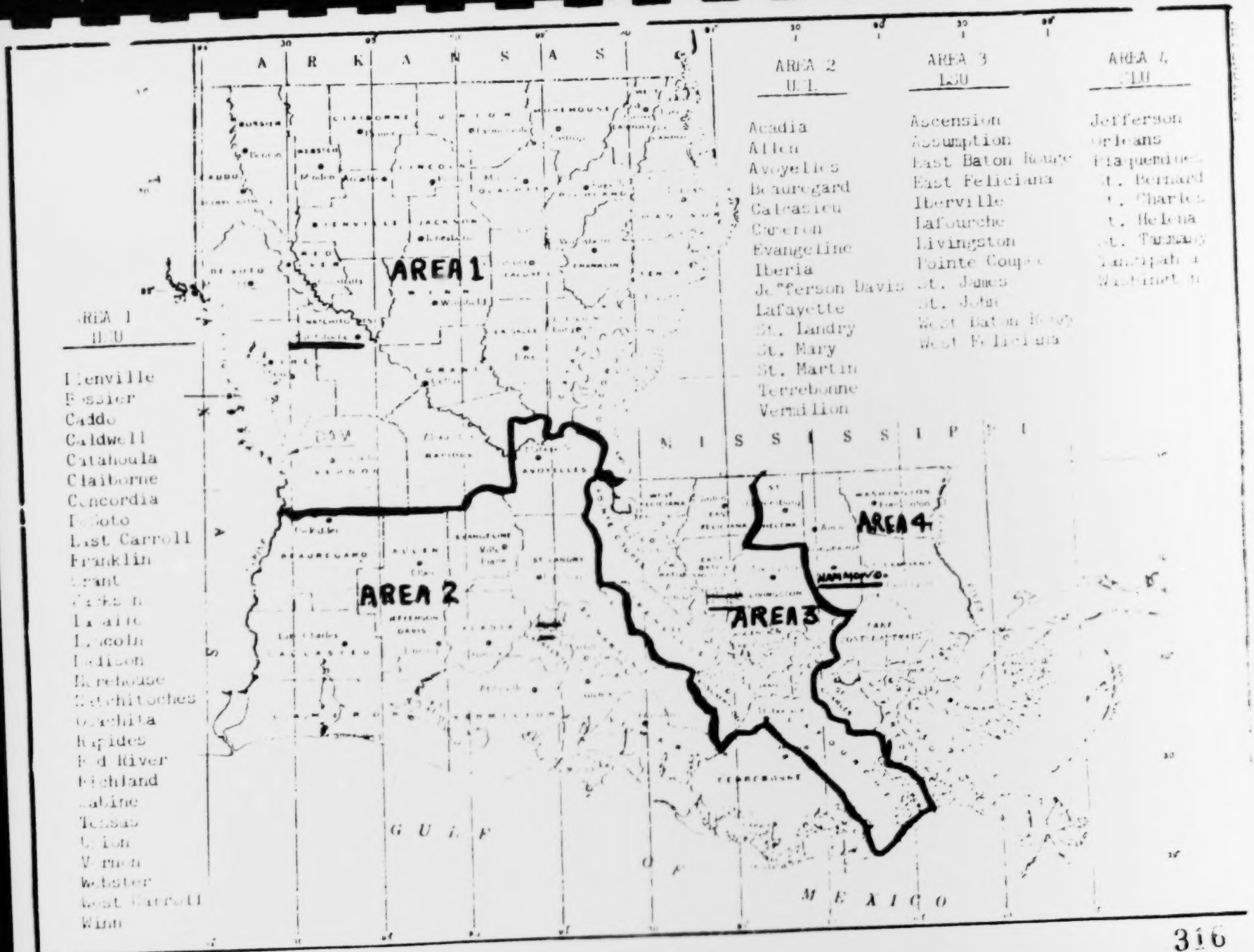
ARC (Advanced Recreational Crafts) - Projects should display more advanced techniques in the various craft areas.

GP (Group Projects) - Entrants may enter a project constructed cooperatively in any one or a combination of normally accepted areas of industrial arts, by a small group of students. This is not mass production. The general knowledge test scores for each student in the group will be averaged to determine the test score part of their total score.

BO (Basic Open) - This is for the student who is in his/her first or second course of industrial arts.

NOTE: The basic open and advanced open classifications are for entries that do not fall into one of the other classifications. Group projects are not allowed in this area. This classification is primarily for multi-area type projects. Each student's general knowledge test score will be used to determine half his/her total score as in other classifications.

AO (Advanced Open) - This is for the student who is in his/her third or fourth course of industrial arts.


AREA 1
AREA 2
AREA 3
AREA 4
ARKANSAS
MISSISSIPPI
GULF OF MEXICO
AREA 2
U. L.
Acadia
Allen
Avoyelles
Beauregard
Calcasieu
Cameron
Evangeline
Iberia
Jefferson Davis
Lafayette
St. Landry
St. Mary
St. Martin
Terrebonne
Vermilion
AREA 3
L.U.
Ascension
Assumption
East Baton Rouge
East Feliciana
Iberville
Lafourche
Livingston
Pointe Coupee
St. James
St. John
West Baton Rouge
West Feliciana
AREA 4
U.
Jefferson
Orleans
Plaquemines
St. Bernard
St. Charles
St. Helena
St. Tammany
Tangipahoa
Washington
AREA 1
H.U
Denville
Bossier
Caddo
Caldwell
Catahoula
Claiborne
Concordia
DeSoto
East Carroll
Franklin
Grant
Jackson
Lafayette
Lincoln
Madison
Morehouse
Natchitoches
Ouachita
Rapides
Red River
Richland
Sabine
Tensas
Union
Vernon
Webster
West Carroll
Winn

APPENDIX B

DEADLINE:

LOUISIANA INDUSTRIAL ARTS STUDENT FAIR ENTRY BLANK

Name of School_____

School Address_____ Phone No._____

City_____ Zip Code_____

Teachers: Please read the following statement carefully and sign it to verify that your students are eligible to participate in the Fair.

By my signature below as the Industrial Arts teacher of the students entered on this form, I certify that the project or work entered in this year's Fair was the work of the student entering the project or work, and that the work was performed under my supervision as part of the requirements of a regularly scheduled industrial arts class during the current school year.

_____
Signature of Instructor

List all student entrants as indicated below. Return this entry to your Area Fair Director by the deadline date listed in the top right-hand corner of this form.

NAME	I.A. CLASS ENROLLED IN (STATE DEPT. OF ED. BULLETIN 741)	CLASSIFICATION	PROJECT	AIASA MEMBER?
Example: John Doe	Basic Woodworking	BW	End Table	Yes

ATTACH ADDITIONAL SHEETS IF NECESSARY.

GENERAL RULES

AIASA COMPETITIVE EVENTS

I. The officially approved competitive events are:

Bridge Building
Chapter Team
Creed
Drawing Interpretation
(Goodheart-Wilcox)
Dream House
(Modern School Supplies)
Drafting Problems
Electricity/Electronics
(Brodhead-Garrett)
Energy Conservation
Engineering Problems
(Modern School Supplies)
Extemporaneous Speech
Graphic Logo
Industrial Bowl
Metric 500
(PITSCO)
Outstanding AIASA Advisor
Outstanding AIASA Chapter
Outstanding School
(Paxton/Patterson and
Graves Humphreys)
Outstanding AIASA State
Outstanding AIASA Student
(National Association
of Women in Construction)
Prepared Speech
Record Book
Research Paper
Safety Poster
Technical Report Writing
(School Shop Magazine)
Technology Process Display

II. LEVELS AND PARTICIPATION

A. Levels

Individual members will enter the events according to grade level during the current school year as follows:

1. Level I - Junior High and Middle School, Grades 6, 7, 8, 9. (The location of the ninth grade, whether in a junior high building or a senior high building, is not a factor relating to the level (either I or II) of entry for ninth grade students. Ninth grade students must compete in Level I only.)

2. Level II - Senior High School, Grades 10, 11, 12.

B. Participation

1. In chapter and team events, an AIASA chapter must enter the event according to the level which corresponds to its official school classification. (e.g., Thompson Jr. High must enter the Level I chapter team competitive event. Any chapter which has both Level I and II members may enter only as a Level II chapter.)

2. Advisors will be entered in the same [illegible] chapter is entered.

3. Students and advisors must be registered for attendance at the National Conference in order to [illegible] become finalists in competition.

4. AIASA members, advisors, and chapters must be in good standing with AIASA in order to enter any competitive event.

5. Contestants are entitled to have only one (1) entry per event. (e.g., only one Metric 500 cat or only one safety poster, etc.)

6. Conference participants may enter a maximum of six (6) competitive events.

III. Chapter and chapter member entries will be restricted to the following:

(NOTE: The Industrial Bowl - Written contest allows three individual members to enter.)

A. No more than two (2) entries per event per chapter in each of the following:

1. Creed
2. Drafting Problems
3. Drawing Interpretation - Goodheart-Wilcox
4. Electricity/Electronics - Brodhead-Garrett
5. Engineering Problems - Modern School Supplies
6. Extemporaneous Speech
7. Graphic Logo
8. Metric 500 - PITSCO
9. Prepared Speech
10. Research Paper
11. Safety Poster
12. Technical Report Writing - School Shop Specialties

NOTE: A student may enter only one (1) of the following events:

1. Creed
2. Extemporaneous Speech
3. Prepared Speech

B. No more than one (1) entry per chapter in:

1. Bridge Building (2 students per team)
2. Chapter Team (6 students per team)
3. Dream House - Modern School Supplies
4. Energy Conservation
5. Industrial Bowl - Oral (3 students per team)
6. Outstanding AIASA Advisor
7. Outstanding AIASA Chapter
8. Outstanding AIASA Student - National Association of Women in Construction
9. Record Book
10. Technology Process Display

C. A student may enter only one (1) of the following four (4) interview events:

1. Electricity/Electronics - Brodhead-Garrett
2. Energy Conservation
3. Outstanding AIASA Chapter
4. Outstanding AIASA Student

D. Contests which require a pre-conference mail-in deadline to be met:

1. Energy Conservation
2. Outstanding AIASA Advisor
3. Outstanding AIASA Chapter
4. Outstanding AIASA Student - National Association of Women in Construction
5. Research Paper

IV. Awards

A. Awards will be presented to the winning entries in each competitive event at the awards presentation ceremonies. First, second, and third place awards will be presented in the following competitive events:

Bridge Building I & II
Creed I
Chapter Team I & II
Drafting Problems I
Drawing Interpretation I & II
  Goodheart-Wilcox
Dream House I & II
  Modern School Supplies
Electricity/Electronics I & II
  Brodhead-Garrett
Energy Conservation I & II
Engineering Problems II
  Modern School Supplies
Extemporaneous Speech I & II
Graphic Logo I & II
Industrial Bowl (Written and Oral) I & II
Metric 500 I & II
  PITSCO
Outstanding AIASA Advisor I & II
Outstanding AIASA Chapter I & II
Outstanding AIASA School I & II
  Paxton/Patterson and Graves Humphreys
Outstanding AIASA State I & II
Outstanding AIASA Student I & II
  National Association of Women in Construction
Prepared Speech I & II
Record Book I & II
Research Paper II
Safety Poster I & II
Technical Report Writing I & II
  School Shop Magazine
Technology Process Display I & II

B. Finalists will be identified in all events. Those not receiving an award will receive recognition at the awards presentation by introduction and a certificate to be distributed at a later date. The number of finalists for a given event will be determined for each level and event as follows:

1. 7 or less entries	3 finalists
2. 8-12 entries	4 finalists
3. 13-17 entries	5 finalists
4. 18-23 entries	6 finalists
5. 24 or more entries	7 finalists

C. First, second, and third place awards are included in the number of finalists.

V. Participation

A. It is the intent of AIASA, Inc. to involve as many different AIASA members as possible for competitive events and recognition in a setting of fair-play practices and guidelines.

B. In the event a question or problem arises that has not been covered in the "General Rules" or the individual competitive event guidelines, the Rules Interpretation Panel will render a decision for the conference.

Should a conflict develop that prevents a member from participating in more than one event, the contestant will decide which contest entry will be eliminated.

C. It will be the individual responsibility of all contestants to obtain all rules and guidelines for concerned events. Lack of knowledge or understanding about a particular event will not be reason or excuse for individual change or adjustment consideration.

D. Contest concerns during the AIASA National Conference for any event should be submitted in writing to the Rules Interpretation Panel.

TEACHER'S DAILY LESSON PLAN

SAMPLE 5

COURSE: _____ LESSON TITLE Recognizing Student Achievements

TEACHER _____ UNIT TITLE _____

LESSON COMPETENCY TASK: (AIASA GOAL OR CONCEPT TO BE LEARNED)

Practice for, and participate in, competitive events to learn Industrial Arts and earn recognition for achievements.

PERFORMANCE OBJECTIVES: (CRITERIA FOR EVALUATION STUDENT LEARNING)

Within this Industrial Arts course, the students will be able to organize, manage and participate in contests, exhibits or demonstrations which motivate students to learn and provide recognition for their achievements.

GENERAL PROCEDURES: (SUGGESTIONS FOR TEACHER)

1. Tell students about the various AIASA contests and booth exhibits which are a part of the Regional, State, and National Leadership Conferences.
2. Explain to students that contests, exhibits and demonstrations give recognition to those who achieve and this is similar to other things like merit pay, athletics, and even auto racing.
3. Help students realize that certain contests, exhibits or demonstrations are related to the class or others can be developed.
4. Share contest rules as distributed in the Spring Festival Permanent Rules.
5. Suggest topics for contests, places to exhibit or groups to see demonstrations.
6. Show samples of awards, ribbons, trophies or plaques that are used to recognize achievements.

CLASS ACTIVITY: (OVERVIEW OF STUDENT PERFORMANCES)

Class officers will conduct a meeting to decide which contests will provide recognition to students who achieve. Recognition Committee will organize contests, exhibits, or demonstrations for the class. Class members will compete with each other or work together on a recognition event such as an open house.

LESSON ASSIGNMENT: (DUTIES OF STUDENTS)

Class Officers: Conduct a class meeting wherein your teacher will give a lesson on Recognizing Achievements. Reporter serves on the committee. After the committee selects appropriate contests, exhibits or demonstrations, the officers will conduct class meeting to select those to be used for the class. The officers will announce when the next class meeting will be held to allow time for this activity.

Committee Members: 1) Use Spring Festival Permanent Rules and National Conference Rules to select contest related to unit of study, 2) Seek additional ways to compete, exhibit or demonstrate learning, 3) Report appropriate ideas to class for selection of best ones, 4) Organize contests or other events with assistance of the teacher, 5) Reporter should announce activity to school and community, 6) Purchase or make awards for those who achieve, 7) Invite others to observe activity, 8) Reporter should write news story about students who achieved.

REFERENCES: (RESOURCES AND HANDOUTS)

Duties for In Class Contests. Page 49
Duties for In Class Open House Exhibits. Page 49
Schedules for Recognition Events. Page 49
Regional, State and National Recognition Events for Industrial Arts Students. Page 50
Checklist for Contest Participants. Page 50

(See other references in Resource Section III.)

RELATED ACTIVITIES:

Hold competitions or exhibits where younger students will learn about Industrial Arts.
Devise a recycling contest for school.
Solve a problem by inviting technical solutions to be entered in a class contest.

TEST QUESTIONS: (RELATE TO OBJECTIVES AND CRITERION REFERENCED MEASURES)

List at least five contests related to class.
Prepare a schedule of practice sessions for one contest.
Describe proper dress and manners for competitive events.

DUTIES FOR IN CLASS CONTESTS OR RECOGNITION

This activity will involve students in contests which are provided at local, regional, state and national conferences. Thus, students may practice and compete in tool identification, prepare an exhibit or give a speech as part of the way they are learning Industrial Arts. The teacher should suggest those contests to the Recognition Committee that relate to the course the students are taking.

Officer and Committee Duties

Recognition Committee: This committee of the class meets to determine what contests relate to class and study rules for possible contests to be held in class or laboratory.

President: Opens class meeting to hear report of Recognition Committee and involve students in selecting contest for class to use.

Vice-President: Assists with organizational chart to show how students will complete.

Secretary: Writes letters to persons who will be asked to serve as judges.

Treasurer: Assists in determining and purchasing awards to be given to winners.

Parliamentarian: May help select judges for contests and review rules for participation.

Sgt. at Arms: May assist judges in keeping order or use of rules.

Reporter: Writes up news stories about contests, exhibit or demonstration and announces winners. May invite community or other students to see contests.

Historian: Keeps records of each activity and files records or photos for future reference.

DUTIES FOR IN CLASS OPEN HOUSE EXHIBITS

This activity will involve students in gaining recognition for their achievements in this industrial arts course. The officers of the class will assist with the activity and every student will not only help but will also contribute projects to be exhibited.

OFFICER AND COMMITTEE Duties

Recognition Committee: This committee of the class meets to determine what type of Open House will be appropriate to the course and works with teacher to arrive at the best date.

President: Opens class meeting to hear report of the Recognition Committee and involve class members in the decisions related to the Open House.

Vice-President: Assists with the organizational procedures and work assignments of committee members and officers.

Secretary: Writes letters or helps with invitations send to school personnel and others class wants to invite.

Treasurer: Records expenses incurred during the Open House activity and seeks funds to meet these costs.

Parliamentarian: Makes sure that proper procedures are followed as visitors are invited or other arrangements are made within the class or school.

Sgt. at Arms: May assist committee in setting up exhibit tables and arranging for and cleaning up after open house.

Reporter: Helps to publicize the Open House around the school. Takes photos and writes story before and after the event for the newspaper.

Historian: Files and keeps information or photos of the event for use by future students.

SCHEDULES FOR RECOGNITION EVENTS

USING A CONTEST IN CLASS

1. Teacher presents idea and purpose of contest during class time.
2. Recognition Committee suggests possible contests for class to use.
3. Officers lead class meeting to decide of contest to be used.
4. Committee reviews or plans rules and organizes time schedule for individuals to compete.
5. Students practice during class or as homework.
6. Students or other judges select up to six finalists.
7. Finalists compete before judges and awards are presented to each.
8. Reporter and other officers carry out their duties.

ENTERING A CONTEST

1. Obtain and study contest guidelines or rule books.
2. Complete forms to pre-register in contest.
3. Mail forms to Spring Festival Contest Chairperson.
4. Prepare and practice for event in class, school and as homework.
5. Demonstrate to class and other school groups for judging or criticism.
6. Dress and conduct oneself appropriately for judging.
7. Appear at scheduled time for contest and awards program.

HOLDING AN OPEN HOUSE

1. Class decides if open house will be by class alone or request school AIASA to cooperate.
2. Obtain permission from school office date and place of open house.
3. Organize class members to help with various set-up details.
4. Announce to students how to enter projects for open house exhibit.
5. Send invitations to school personnel, parents and community resources.
6. Provide recognition for those who participate.

GIVING A TECHNICAL DEMONSTRATION

1. Select a technical topic which would interest or help other people.
2. Prepare research report or speech on the topic of demonstration.
3. Make models or assemble tools for demonstration.
4. Practice giving demonstration in class, school or as homework.
5. Arrange time and place to give demonstration such as State Fair, shopping mall or open house.
6. Dress and conduct oneself in professional way prior to and during demonstration.
7. Provide demonstration and answer questions of those who watched.

REGIONAL, STATE AND NATIONAL RECOGNITION EVENTS FOR INDUSTRIAL ARTS STUDENTS

TECHNICAL PERFORMANCE CONTESTS
- Architectural Drawing
- Engineering Drawing
- Electricity/Electronics
- Graphic Arts
- L.S.R.A.V. (model race cars)
- Leathercraft
- Photography
- Metal Machining
- Small Engine Trouble Shooting
- Tool and Machine Identification
- Woodturning - between centers
- Woodturning - face plate
- Screen Process Printing (hand cut film)
- Metric 500 Race

GENERAL CONTESTS
- General Knowledge Test
- Public Speaking Contests (prepared and extemporaneous)
- Chapter Team Contest
- Research Paper Entry Contest
- Safety Poster Entry Contest
- Technical Writing Contest

- Booth or Display Contests
- Co-Curricular Activity Exhibit
- Community Service Project Exhibit
- Scrapbook or Record Book Exhibit
- Fund Raising Project Exhibit
- Booth Exhibit

PROJECT EXHIBIT CONTESTS (enter by course title and course code)
- Exploring Technology
- Modern Industry
- Construction
- Manufacturing
- Communications Technology
- Materials and Processes Technology
- Power and Transportation Technology
- Architectural Drawing
- Basic Technical Drawing
- Electricity and Electronics
- Energy and Power
- Engineering Drawing
- Graphic Communications
- Metals Technology
- Woods Technology
- General Industrial Arts
- Industrial Crafts

(for other titles see Spring Festival Permanent Rules)

CHECKLIST FOR CONTEST PARTICIPANTS

Directions: Performance and leadership contests are judged on the following aspects. To assist students to improve themselves for the contest these statements can be checked off by another person.

Technical Understanding

_____1. Accurate information used from books and research.
_____2. Impact or value of technology understood.
_____3. Safety procedures are used or described.
_____4. Information reviewed or approved by teacher.

Leadership

_____1. Leadership ability is exhibited.
_____2. Experienced as officer or participant in AIASA.
_____3. Voice and mannerisms are appropriate.
_____4. Assists with projects of class.
_____5. Helped arrange materials and forms for entry into contest.
_____6. Sent registration materials to contest chairperson.

Career Information

_____1. Knows at least 5 careers related to contest.
_____2. Understands requisites for career entry.
_____3. Lists programs for occupational preparation.

Performance

_____1. Shows interest and enthusiasm.
_____2. Dressed appropriate to contest.
_____3. Presents or demonstrates information in orderly manner.
_____4. Develops eye contact.
_____5. Voice and manner professional.
_____6. Paper organized well and holds interest.
_____7. Writing is accurate and to the point.

TEACHER'S DAILY LESSON PLAN

SAMPLE 2

COURSE: _____

TEACHER _____

LESSON TITLE Using Industrial Community Resources

UNIT TITLE _____

LESSON COMPETENCY TASK: (AIASA GOAL OR CONCEPT TO BE LEARNED)

Identify and arrange for industrial speaker or tour to assist class in learning Industrial Arts.

PERFORMANCE OBJECTIVES: (CRITERIA FOR EVALUATION STUDENT LEARNING)

Within this Industrial Arts course, the student will be able to list industrial and community resources, select at least three (3) appropriate to the unit of study, and arrange for a speaker or tour.

Within this Industrial Arts course, the student will be able to conduct a survey of industries or use a questionnaire during interview with industrial career persons.

GENERAL PROCEDURES: (SUGGESTIONS FOR TEACHER)

1. Tell students about the value of personal contact with community resources for learning the content of this Industrial Arts course.
2. Review with students the components of a good business letter.
3. Show the students how to obtain information about industries or businesses in the community, city or county from libraries and directories.
4. Ask the students to list names of resources by open discussion and brainstorming.
5. Assign the Community Resources Committee to review the list and report back to class for vote on best choice for class.
6. Talk with speaker or tour guide before visit to review purposes of activity.
7. Assist students in follow-up, writing letters, and record-keeping files of recor..
8. Stress the importance of Industrial Arts as the study of industry and technology.

CLASS ACTIVITY: (OVERVIEW OF STUDENT PERFORMANCES)

Class officers will conduct a meeting to decide which industrial and community resources will be used to learn a certain unit of Industrial Arts. A Community Resources Committee meets to list and select appropriate speakers or industrial tours. The class will vote on the best resource. With help from the teacher and principal, the speaker is called or a letter is written. If all students are not permitted to visit the industry, the committee may visit and report to the class. Afterwards, a thank you letter should be written to the persons who assisted the class or committee.

LESSON ASSIGNMENT: (DUTIES OF STUDENTS)

SPECIAL EQUIPMENT:

Class Officers: Conduct a class meeting wherein your teacher will give a lesson on Using Community Resources. Historian serves on the committee. After the committee selects appropriate resources, the officers will conduct a meeting to select one. The officers will announce when the next class meeting will be held to allow time for this activity.

Committee Members: 1) Use library, Chamber of Commerce Directories or yellow pages to find industry or business related to unit of study, 2) After class votes on best resource, committee writes letter to invite speaker or arrange tour, 3) Parliamentarian obtains permission forms from principal's office if required, 4) Follow-up is made to check on arrangements, 5) If class is not permitted to visit industry, the committee may make visit and report to class, 6) Thank you letter is written to speaker or industry, 7) Records are kept in file for use by other class or school chapter.

REFERENCES: (RESOURCES AND HANDOUTS)

Directories of industries in community.
Listings of agencies or organizations.
Parents, other teachers, former students.
Duties for In Class Use of Community Resources. Page 40
Typical Schedule for Using a Speaker. Page 40
(See other references in Resource Section III.)

RELATED ACTIVITIES:

Invite career speakers.
Visit placement/personnel offices.
Make T.V. tape of resources.
Organize a career day for class or with chapter.
Honor an industry in community.
Enlist students in community activities related to course.

TEST QUESTIONS: (RELATE TO OBJECTIVES AND CRITERION REFERENCED MEASURES)

List industries in community related to course.
Write sample letter explaining how the speaker from local agency or industry would be a helpful resource to class.
Describe what was learned by visit to an industrial or community resource.